Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

2012 Pest Management Research Report (PMRR) 2012 Growing Season

2012 Rapport de recherches sur la lutte dirigée (RRLD) pour la saison 2012

Canada

English

2012 PEST MANAGEMENT RESEARCH REPORT

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

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

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

This year there were 13 reports. Agriculture and Agri-Food Canada is indebted to the researchers from provincial and federal departments, universities, and industry who submitted reports, for without their involvement there would be no report. Special thanks is also extended to the section editors for reviewing the scientific content and merit of each report and to Diane Holmes for editorial and computer compilation services.

Suggestions for improving this publication are always welcome.

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Procedures for the 2013 Annual PMR Report will be sent in fall, 2013. They will also be available from Diane Holmes.

Pest Management Research Report History.

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

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

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

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

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

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

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

The publication of the Report for the growing season 2012 has been assigned a Volume number for the thirteenth year. Although there was a name change since it was first published, the purpose and format of the publication remains the same. Therefore, based on the first year of publication of this document, the Volume Number will be Volume 51.

An individual report will be cited as follows:
Author(s). 2012. Title. 2012 Pest Management Research Report - 2012 Growing Season. Agriculture and AgriFood Canada. February 2013. Report No. x. Vol. 51: pp-pp.

Français

Rapport de recherches sur la lutte dirigée - 2012

Préparé par: Centre de la lutte antiparasitaire, Agriculture et Agroalimentaire Canada
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[1]Ce numéro est basé sur le nombre d'année que le rapport a été publié. Voir l'histoire en page iv.

La compilation du rapport annuel vise à faciliter la diffusion des résultats de la recherche dans le domaine de la lutte antiparasitaire, 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 Santé Canada, Agence de réglementation de la lutte antiparasitaire à 1-800-267-6315.

Cette année, nous avons donc reçu 21 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 Diane Holmes qui a fourni les services d'édition et de compilation sur ordinateur.

Vos suggestions en vue de l'amélioration de cette publication sont toujours très appréciées.

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Des procédures pour le rapport annuel de 2013 PMR seront introduites à l'automne 2013. Elles seront aussi disponibles par Diane Holmes.

Historique du Rapport de recherche sur la lutte dirigée

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

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

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

En 2000, on a commencé à attribuer un numéro de volume au rapport annuel. Même si ce dernier a changé de titre depuis sa création, sa vocation et son format demeurent les mêmes. Ainsi, si l'on se reporte à la première année de publication, le rapport portant sur la saison de croissance de 2009 correspond au volume 48.

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

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

Modèle de référence:
Nom de l'auteur ou des auteurs. 2012. Titre. 2012 Rapport de recherche sur la lutte dirigée. Agriculture et Agroalimentaire Canada. fevrier, 2013. Rapport n^{o} x. vol. 51: pp-pp.

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2012 PMR REPORT# 01 **SECTION B: VEGETABLES and SPECIAL CROPS - Insect Pests**

CROP: Yellow cooking onions (*Allium cepa* L.), cv. LaSalle
PEST: Onion thrips, (*Thrips tabaci* Lindeman)

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TITLE: **EVALUATION OF FOLIAR INSECTICIDES TO CONTROL ONION THRIPS IN YELLOW COOKING ONIONS, 2012**

MATERIALS: CONCEPT (imidacloprid 75 g/L, deltamethrin 10 g/L), DELEGATE WG 400 (spinetoram 25%), MOVENTO 240 SC (spirotetramat 240 g/L), MATADOR 120 EC (lambda-cyhalothrin 120 g/L) AGRI-MEK (abamectin 1.9%), DIBROM (naled 864 g/L), SYLGARD 309 (siloxylated polyether 76%), GOWAN 10021 (experimental)

METHODS: Onions, cv. LaSalle, were direct seeded (34 seeds/m) in muck soil (pH ≈ 7.0, organic matter ≈ 57%) using a Stanhay Precision Seeder near the Muck Crops Research Station, Holland Marsh, Ontario on 7 May. A randomized complete block arrangement with four replicates per treatment was used. Each replicate consisted of two beds each with four twin rows (40 cm apart), 10 m in length. Two 2.32 m sections of row were marked for yield samples. The first application of insecticide was applied on 20 July when thrips counts reached the threshold of one thrips per leaf. Subsequent applications were applied 30 July, 8 and 15 August. A tractor-mounted sprayer fitted with AI TeeJet® Air Induction Even Flat spray tips (AI9503 EVS) at 120 psi, delivering 500 L water/ha was used. Products, rates and abbreviations and the dates of spray applications were as shown in Tables 1 & 2 respectively. Adult and larval thrips were counted on the inside leaves of 20 randomly pulled onions per replicate on 18 and 24 July, 2 and 13 August and on 10 onions per replicate on 20 August. On the last assessment date onions were 50% lodged. On 28 September, when onions tops were dry, all onions in the two 2.33 m sections rows designated for yield were pulled and placed in storage. On 30 October onion samples were removed from storage and sorted by size to determine total and marketable yield. Compared to the averaged previous 10 years, the air temperatures in 2012 were average for August (20.1°C), and September (14.8°C), and above average for May (15.9°C), June (20.1°C) and July (22.2°C). The long term previous 10 year average temperatures were: May 12.3°C, June 18.2°C, July 20.7°C, August 19.5°C, and September 15.8°C. Monthly rainfall was below the previous long term 10 year average for May (49 mm) and June (55 mm), average for September (75 mm), and above average for July (140 mm), and August (79 mm). The long term previous 10 year rainfall averages were: May 77 mm, June 74 mm, July 81 mm, August 67 mm, and September 74 mm. Data were analyzed using the general analysis of variance function of the Linear Models section of Statistix V. 9. Comparison of means was done using Fisher's Protected LSD Test with $P < 0.05$.

RESULTS: As presented in Tables 2 and 3.

CONCLUSIONS: Temperatures were above average in May, June and July and consequently thrips populations increased rapidly in 2012. By 13 August, thrips numbers were reduced to acceptable levels (6 to 18 thrips per plant) after two applications of MOVENTO plus SYLGARD followed by one application of either DELEGATE, CONCEPT, AGRIMEK, GOWAN, or MATADOR, or three applications of DELEGATE or MOVENTO plus SYLGARD or DIBROM, followed by MOVENTO plus SYLGARD, followed by DIBROM (Table 3).

Onions sprayed with three applications of either DELEGATE or AGRIMEK or a regime of two applications of MOVENTO plus SYLGARD followed by AGRIMEK, had significantly higher yields than onions sprayed with two applications of MATADOR followed by CONCEPT, three applications of MATADOR, SYLGARD or DIBROM or the untreated check (Table 4). MOVENTO used in combination with other insecticides in a spray program is effective for controlling thrips and may help prevent resistance in thrips populations.

ACKNOWLEDGEMENT: Funding for this project was provided by the Bradford Co-operative & Storage Ltd. through the Holland Marsh Growers' Association and Plant Production Systems of the Ontario Ministry of Agriculture, Food and Rural Affairs and the University of Guelph partnership .

Table 1. Rates of products and key for abbreviations used in the spray program for control of thrips on onions, cv. LaSalle, grown near the Muck Crops Research Station, Holland Marsh, Ontario, 2012.

Product	Rate per ha	Abbreviations Used in Tables 2 & 3
CONCEPT OD	650 mL	CON
DELEGATE WG	336 mL	DEL
MOVENTO 240 SC	375 mL	MOV
SYLGARD 309	0.25% v/v	SYL
MATADOR 120 EC	188 mL	MAT
AGRI-MEK SC	1.0 L	AGR
DIBROM	550 mL	DIB
GOWAN 10021 (experimental)	2% v/v	GOW

Table 2. Insecticide spray program for control of thrips on onions, cv. LaSalle, grown near the Muck Crops Research Station, Holland Marsh, Ontario, 2012.

No.	1st App 20 Jul	2nd App 30 Jul	3rd App 8 Aug	4th App 15 Aug
1	CON[1]	CON	CON	CON
2	DEL	DEL	DEL	DEL
3	MOV + SYL	MOV + SYL	MOV + SYL	MOV + SYL
4	MAT	MAT	MAT	MAT
5	AGR	AGR	AGR	AGR
6	DIB + SYL	DIB + SYL	DIB + SYL	DIB + SYL
7	SYL	SYL	SYL	SYL
8	MOV + SYL	MOV + SYL	GOW	GOW
9	MOV + SYL	MOV + SYL	AGR	AGR
10	MOV + SYL	MOV + SYL	DEL	DEL
11	MOV + SYL	MOV + SYL	CON	CON
12	MOV + SYL	MOV + SYL	MAT	MAT
13	DIB + SYL	MOV + SYL	MOV + SYL	DIB + SYL
14	---[2]	---	---	---

[1] See Table 1 for rates and the full product names referred to by these abbreviations.
[2] Untreated check

Table 3. Onion thrips counts for onions, cv. LaSalle, treated with various insecticides grown near the Muck Crops Research Station, Holland Marsh, Ontario, 2012.

#[1]	Treatment[2]	Mean # OT/Plant					AUIPC[3]
		18 July	24 July	2 Aug	13 Aug	20 Aug	
10	MOV[4]/DEL	25.8 ns[5]	46.7 ns	12.2 a[6]	5.9 a	5.2 a	620.1 a
11	MOV/CON	20.5	38.6	6.9 a	12.1 ab	24.9 a	616.1 a
9	MOV/AGR	24.3	43.9	9.8 a	12.6 ab	22.4 a	691.7 a
8	MOV/GOW	25.3	45.6	12.1 a	14.9 ab	30.7 ab	779.8 a
12	MOV/MAT	23.6	51.5	13.7 a	15.2 ab	27.8 a	828.4 a
3	MOV	28.5	54.0	12.1 a	17.0 ab	13.7 a	812.2 a
13	DIB/MOV/DIB	24.4	52.1	50.6 b	17.3 ab	17.1 a	1185.2 abc
2	DEL	31.9	22.2	13.2 a	17.6 ab	6.4 a	575.6 a
5	AGR	22.5	37.3	22.8 a	44.3 bc	22.3 a	1051.5 ab
1	CON	20.1	49.0	60.1 b	55.6 c	24.0 a	1612.7 bcd
7	SYL	27.2	59.1	49.9 b	60.0 c	57.8 bc	1765.2 cd
4	MAT	20.2	53.0	53.1 b	69.7 c	69.1 c	1858.1 d
6	DIB	28.0	46.3	45.6 b	74.3 c	59.0 bc	1762.1 cd
14	Check	27.0	48.5	55.0 b	108.9 d	71.3 c	2225.0 d

[1] Treatment numbers refer to the spray program described in Table 2.
[2] See Table 1 for full product names referred to using these abbreviations
[3] Area under the insect pressure curve (AUIPC) = $\sum (Y_i+Y_{i+1})/2(t_{i+1}-t_i)$
[4] All MOVENTO treatments were applied with the surfactant SYLGARD 302 at 0.25% v/v
[5] ns indicates no significant differences were found among the treatments
[6] Means in a column followed by the same letter are not significantly different at P=0.05, Fisher's Protected LSD test.

Table 4. Yield and size distribution for onions, cv. LaSalle, treated with foliar insecticides for control of onion thrips grown near Muck Crops Research Station, Holland marsh, Ontario, 2012.

#[1]	Treatment[2]	Marketable Yield (t/ha)	Size distribution (%)		
			Large (64-76 mm)	Medium (45-64 mm)	Small (<45 mm)
2	DEL	31.5 a[2]	6.3 ns[3]	77.5 ns	16.2 ns
5	AGR	30.6 ab	11.5	71.1	17.4
9	MOV[4]/AGR	28.7 ab	9.8	75.0	15.3
8	MOV/GOW	27.5 abc	3.5	77.0	19.5
10	MOV/DEL	26.6 abc	10.6	70.3	19.0
3	MOV	25.5 a-d	8.4	71.4	20.2
1	CON	25.2 a-e	11.7	68.5	19.8
13	DIB/MOV/DIB	24.4 a-e	4.9	76.3	18.8
12	MOV/MAT	24.1 a-f	8.0	67.2	24.8
11	MOV/CON	22.9 b-f	6.9	68.3	24.8
4	MAT	20.6 c-f	5.8	71.0	23.1
7	SYL	18.3 def	2.1	68.9	29.0
14	Check	16.8 ef	5.3	69.5	25.1
6	DIB	16.2 f	2.3	63.1	34.5

[1] Treatment numbers refer to the spray program described in Table 2.
[2] See Table 1 for full product names referred to using these abbreviations
[2] Means in a column followed by the same letter are not significantly different at P=0.05, Fisher's Protected LSD test.
[3] ns indicates no significant differences were found among the treatments
[4] All MOVENTO treatments were applied with the surfactant SYLGARD 302 at 0.25% v/v

2012 PMR REPORT # 02 **SECTION B: VEGETABLES and SPECIALTY CROPS – Insect Pests**

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

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TITLE: EVALUATION OF INSECTICIDES FOR CONTROL OF ONION MAGGOT IN YELLOW COOKING ONIONS, 2012

MATERIALS: APRON XL LS (metalaxyl-M 33.3%), AVICTA 400 (abamectin 37%), CAPTURE 2EC (bifenthrin 25.1%), CRUISER 70 WS (thiamethoxam 70.0%), ENTRUST 80 W (spinosad 80%), FORCE 3.0 G (tefluthrin 3.0%), LORSBAN 15 G (chlorpyrifos 15%), MOVENTO 240 SC (spirotetromat 240 g/L), PENFLUFEN FS 50 (penflufen 4.81%), SEPRESTO (clothianidin 56.25% + imidacloprid 18.75%), SYLGARD 309 (siloxylated polyether 76%), TRIGARD (cyromazine 75%)

METHODS: Various insecticide seed treatments, granular insecticides and foliar sprays were evaluated on yellow cooking onions in a field trial on organic soil (pH ≈ 6.4, organic matter ≈ 74.4%) naturally infested with *Delia antiqua* pupae at the Muck Crops Research Station, Holland Marsh, Ontario. A randomized complete block design with four replicates per treatment was used. Each experimental unit consisted of 4 rows, spaced 42 cm apart, 6 m in length. All onions were seeded on 11 May using a push cone seeder for seed treatments or a V-belt seeder for granular insecticide applications. Seed treatments were: TRIGARD at 5.0 g ai/100 g of seed, SEPRESTO at 6.15 g ai/100 g of seed, ENTRUST + CRUISER at 5.13 g ai + 2.56 g ai/100 g of seed, ENTRUST and AVICTA, at 5.13 g ai/100 g of seed. FORCE at 9.4 kg/ha, CAPTURE at 11.4 L/ha, MOVENTO at 375 mL/ha + SYLGARD at 0.375% v/v, and LORSBAN at 32 kg/ha. An untreated check was also included. All seeds were also treated with APRON XL at 15 mg ai/ 100 g seed, and PENFLUFEN FS 50 at 250 mg ai/100 g seed. Seeds were treated at Cornell University by Alan Taylor. LORSBAN and FORCE were applied as granular treatments on 16 May, CAPTURE was applied as a drench and MOVENTO + SYLGARD was applied as a foliar treatment on 17 July using a CO_2 backpack sprayer equipped with four 8002VK TeeJet fan type nozzle calibrated to deliver 375 mL/ha at 240 kPa. Three random 2 m sections were staked out in each experimental unit. Germination counts were conducted on 30 May and 6 June to determine initial stands prior to the first generation assessment. Plants were examined for onion maggot (OM) or damage caused by other pests within the staked-out sections on 8, 14, 21 June and 5 July. Damaged plants were removed and the cause recorded. OM damage was assessed two weeks after the end of the first (June) and second (August) generation peaks and at onion bulb maturity (10 September). On 12 September onions from a 2.33 m section of row were harvested and on 1 November, bulbs were counted and yield determined. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.9. Means separation was obtained using Fisher's Protected LSD Test at $P = 0.05$ level of significance.

RESULTS: As presented in Table 1.

CONCLUSIONS: Significant differences in percent onion maggot losses were observed after the first generation and in total onion maggot damage for the season (Table 1). After first generation assessments, all seed treatments and FORCE (granular) and CAPTURE (drench) treatments had significantly lower OM losses than the untreated check and standard LORSBAN treatment. At bulb maturity, total onion maggot damage was significantly lower in the TRIGARD, ENTRUST and ENTRUST + CRUISER 70 WS treatments than the FORCE and LORSBAN treatments and the untreated check. No significant differences in marketable yield were observed among the treatments.

ACKNOWLEDGEMENT: Funding was provided by the Holland Marsh Growers' Association through the Bradford Cooperative and Storage Ltd., and the California Onion and Garlic Research Advisory Board. The New York State Agricultural Experiment Station, Cornell University provided support for seed treatment application of new chemistry seed treatments. Any opinions, findings, conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of Cornell University or those of Rutgers, State University of New Jersey.

Table 1. Evaluation of seed treatments for control of onion maggot damage in onions, grown at the Muck Crops Research Station, Holland Marsh, Ontario, 2012.

Treatment	Application Type[1]	Rate (g ai/100 g seed)	% Onion Maggot Losses		t/ha
			1st Gen	Total Season	
TRIGARD	ST	5.0	1.3 a[2]	7.0 a	80.1 ns[3]
ENTRUST + CRUISER	ST	5.13 +2.56	2.1 a	6.7 a	82.1
SEPRESTO	ST	6.15	2.3 a	7.9 ab	66.2
AVICTA	ST	5.13	3.6 a	8.5 ab	77.9
ENTRUST	ST	5.13	4.5 a	5.0 a	72.6
FORCE	G	0.38 g/m of row	5.9 a	20.0 cd	71.5
CAPTURE	D	0.46 mL/m of row	6.5 a	9.6 abc	82.5
MOVENTO + SYLGARD	F	375 ml/ha	11.9 ab	12.7 abc	64.6
LORSBAN	G	32 kg/ha	20.3 bc	18.8 bcd	59.4
Check		--	24.5 c	25.4 d	65.5

[1] ST = Seed treatment, G = granular application, D = drench application, F = foliar spray.
[2] Numbers in a column followed by the same letter are not significantly different at $P = 0.05$, Fisher's Protected LSD test.
[3] ns = no significant differences

2012 PMR REPORT # 03 **SECTION B: VEGETABLES AND SPECIAL CROPS – Insect Pests**

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

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TITLE: **EVALUATION OF DPX-HGW86 WITH AND WITHOUT SURFACTANT FOR CONTROL OF ONION THRIPS ON ONIONS, 2011**

MATERIALS: DPX-HGW86 10 SE (cyantraniliprole 100 g/L), AGRAL 90 SL (nonylphenoxy polyethyoxyethanol 90.0%), HASTEN NT (methyl and ethyl oleate (esterified vegetable oil) 71.44%), LI-700 EC (phosphatidylcholine, methylacetic acid and alkyl phenol ethoxylate 80%)

METHODS: Two rows of onion sets were planted into 8 x 2 m plots (75 plants/row) in Breslau, ON on June 30, 2011. All treatments were replicated four times in a randomized complete block design. On 19 and 29 August all treatments were applied in 200 L/ha, at 40 psi, using a hand-held, CO_2 pressurized sprayer fitted with a 2 m boom equipped with 4 hollow cone (Ceramic Disc & Core) nozzles. The total numbers of onion thrips (adults + nymphs) on 10 randomly sampled plants/plot were counted on 19, 22, 24, 26 August, 1, 3, 6, and 13 September. Data were analyzed using ANOVA with means separation with Tukey's HSD. Data collected on 26 August and 03 September were transformed using square root (x + 0.5) function. Untransformed means are presented herein.

RESULTS: Data are presented in Table 1.

CONCLUSIONS: Three days after the first application (DALA) while all plots treated with DPX-HGW86 had fewer onion thrips than the untreated control (UTC), only plots treated with DPX-HGW86 + LI-700 had significantly fewer thrips than the UTC. On the next assessment date, 5 DALA, all DPX-HGW86 treatments had significantly fewer onion thrips than the UTC. Following the second application, all plots treated with DPX-HGW86 (with and without a surfactant) had significantly fewer onion thrips than the UTC on all assessment dates. The greatest reductions in number of onion thrips was observed on 03 September (5 DALA) when all DPX-HGW86 treatments resulted in reductions ranging from 80.2%

(no surfactant) to 86.1% (Agral 90), respectively. Foliar applications of DPX-HGW86 with and without a surfactant reduced the number of onion thrips observed on every assessment date during this trial when compared to the UTC.

Table 1. Impact of DPX-HGW86 with and without surfactants on the number of onion thrips on set onions, Breslau, ON, 2011.

Treatments	Rate ai/ha	Mean No. Onion Thrips/ Plant							
		19 Aug Pre-count	22 Aug 3 DALA[1]	24 Aug 5 DALA	26 Aug 7 DALA	01 Sep 3 DALA	03 Sep 5 DALA	06 Sep 8 DALA	13 Sep 15 DALA
CONTROL	~	4.50 a[2]	2.45 a	5.55 a	6.53 a	8.78 a	14.0 a	19.8 a	27.4 a
DPX-HGW86	100	3.35 a	1.40 ab	2.13 b	3.58 a	2.08 b	2.78 b	5.10 b	9.10 b
DPX-HGW86 + AGRAL 90	100 + 0.25%	3.50 a	0.73 ab	1.63 b	3.55 a	2.10 b	1.95 b	5.38 b	5.83 b
DPX-HGW86 + HASTEN NT	100 + 0.25%	3.55 a	1.10 ab	1.83 b	2.88 a	2.45 b	2.13 b	3.98 b	9.78 b
DPX-HGW86 + LI-700	100 + 0.25%	3.58 a	0.63 b	1.65 b	2.88 a	1.93 b	2.33 b	5.63 b	7.70 b

[1] – Days after last application.
[2] – Means followed by the same letter within a column are not significantly different ($p>0.05$) as determined by ANOVA and Tukey's HSD. Data collected on 26 August and 3 September were transformed using square root ($x + 0.5$) prior to analysis. Untransformed data presented

2012 PMR REPORT # 04 **SECTION B: VEGETABLES and SPECIAL CROPS -Insect Pests**

CROP: Rutabaga, (*Brassica napus* var. *napobrassica* L. Reichenb.), cv. Laurentian, York
PEST: Cabbage maggot (*Delia radicum* (L.))

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TITLE: **ROW COVERS AS PHYSICAL BARRIERS TO CONTROL CABBAGE MAGGOT (DELIA RADICUM) IN RUTABAGA**

MATERIALS: WONDERMESH® WM-16, PROTEKNET® 65g, PYRINEX 480 EC or LORSBAN 4 E (chlorpyrifos 480 g/L), DEVRINOL 50 DF (napropamide 50%), TREFLAN EC or BONANZA L (trifluralin 480 g/L)

METHODS: Two types of polyethylene mesh row covers were tested in the 4 Atlantic Provinces: 1 site in New Brunswick (NB), 1 site in Newfoundland and Labrador (NL), 3 sites in Nova Scotia (NS) and 1 site in Prince Edward Island (PEI). Experiments were established as replicated latin square designs, using rutabaga (cv York or Laurentian) direct-seeded into12m x 13m plots. Treatments were replicated 4 times

and included: Wondermesh® row cover, ProtekNet® row cover, chlorpyrifos (the industry standard) and an untreated, uncovered check. Wondermesh® recommends specific plastic pegs to secure the row cover to the ground whereas Proteknet® recommends bags filled with sand or crushed stone; therefore we used pegs with Wondermesh® and bags with ProtekNet®. The research was conducted on commercial farms with known cabbage maggot infestation. Either PYRINEX or LORSBAN was applied at a rate of 21 ml/100 m row as a directed drench using either a backpack sprayer or a tractor-mounted sprayer. Prior to direct seeding, plots were treated with pre-emergent herbicides. Appropriate fertilizers were applied according to usual production recommendations.

At the end of the experiments, 30-35 rutabaga were chosen randomly from each plot and assessed for yield, marketability and cabbage maggot damage. We used the damage rating scale of King and Forbes (1954) to place each rutabaga in one of the following categories: *clean* - factor of 0, no damage; *light* - factor of 1, slight, superficial early feeding but fully healed; *moderate* - factor of 2, marketable as Grade 2 after single trim just above tap root to remove single deep penetration, or moderate, healed surface injury affecting < 20% of surface that could be removed by peeling; *severe* - factor of 4, unmarketable for table use, injury not removable by practical trimming; any extensive unhealed surface injury; maggot in root. An "Infestation Index" was then calculated for each plot by multiplying the appropriate King and Forbes factor by the % of roots in each category, adding products and dividing the sum by 4. The rutabagas were subsequently categorized as either marketable, unmarketable due to cabbage maggot damage or unmarketable due to other reasons (eg. size, growth cracks, disease). Infestation indices, marketable yields and yields of rutabaga unmarketable due to cabbage maggot damage, were compared between provinces. Data are from the first year (2011) of a two year trial.

The replicated latin square design was analyzed using the ANOVA directive, (GenStat, VSNi) with orthogonal contrast to determine treatment differences. The block structure used for the analysis was plots within replicates within provinces with the treatments applied to plots. Data were $\sqrt{\pm 0.5}$ transformed before analysis.

RESULTS: Wondermesh®, ProtekNet® and chlorpyrifos provided similar levels of cabbage maggot control as measured by 1 - marketable yield (Table 1), 2 - weight of rutabaga unmarketable due to cabbage maggot damage (Table 1) and 3 – infestation index (Figure 1). Cabbage maggot control was significantly better in each treatment compared with the check. This result was consistent across the 4 Atlantic Provinces.

Table 1: Effect of polyethylene row covers on rutabaga yield and cabbage maggot damage in Atlantic Canada, Year 1.

Treatment	Marketable yield (kg/ha)	Unmarketable due to cabbage maggot (kg/ha)
Wondermesh® (WM)	128.5 (16499.9)[1]	43.7 (1908.8)[1]
ProtekNet® (PN)	131.2 (17215.6)	54.9 (3010.9)
Chlorpyrifos (Chlor)	125.0 (15625.8)	62.1 (3854.3)
Check	82.8 (6854.2)	113.7 (12934.2)
Grand mean	116.9 (13657.0)	68.6 (4705.1)
SEM (n=24)	7.8	11.1
Treatment	<.0001	<.0001
Check vs Rest	<.0001	<.0001
Chlor vs WM, PN	NS	NS
PN vs WM	NS	NS

[1] The first number in each column is transformed ($\sqrt{\ } \pm 0.5$) with back transformed means in brackets
NS = not significant

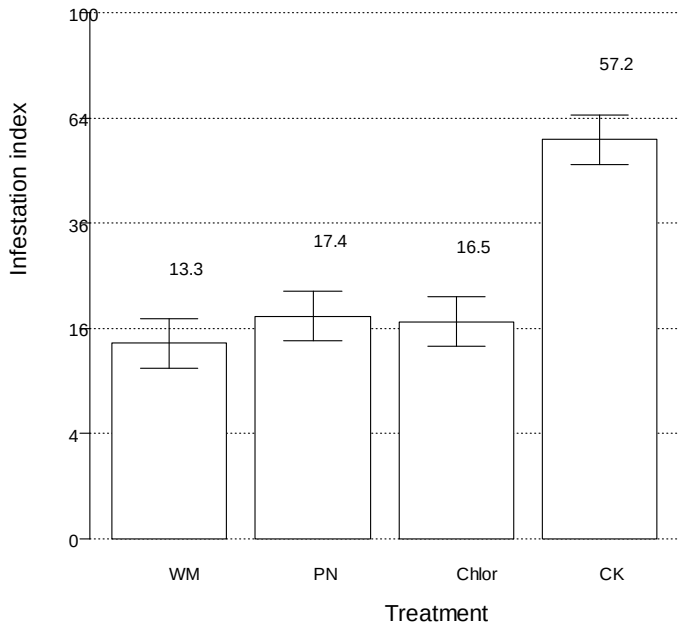

Figure 1: Cabbage maggot infestation indices (square root transformed) in rutabaga grown under one of two types of row cover (Wondermesh® (WM) or Proteknet® (PN)), treated with chlorpyrifos (Chlor) or not treated/covered (CK=check). A higher value indicates more cabbage maggot damage. Values are back-transformed means. Index based on King and Forbes (1954).

CONCLUSIONS: Cabbage maggot pressure was moderate to high at each site. Despite this, both polyethylene row covers performed as well as chlorpyrifos in direct-seeded rutabaga in each province. There was some damage in the row cover and insecticide-treated plots. For the row covers, damage was likely due to the edges not being secured all along their length. The row covers must be 100% secured along the edges so that there are no areas to allow fly entry. This might be best accomplished by burying the edges with soil instead of using either bags or pegs. At some sites but not all, damage was observed in the plots treated with chlorpyrifos; this may be due to a number of factors including insect resistance. The possibility of resistance to chlorpyrifos will be assessed directly in the lab in 2012. While row covers were easy to handle manually in 12m x 13m plots, at commercial scale, equipment will likely be required. Equipment is available to place the row covers in the spring and remove for storage in the fall. Removal for weed control is not possible unless the area covered is very small; thus weed control is of paramount importance. The second year of the project will repeat the Year 1 experiments as well as investigate weed control more thoroughly and complete an economic analysis of the system.

We gratefully acknowledge funding provided by the Pesticide Risk Reduction Program of Agriculture and Agri-Food Canada's Pest Management Centre.

REFERENCES:

King, K.M. and A.R. Forbes. 1954. Control of root maggots in rutabagas. J. Econ. Entomol. 47: 607-615.

2012 PMR REPORT # 05 **SECTION H: PEST MANAGEMENT METHODS-BIOLOGICAL CONTROL**

CROP: Wheat, *Triticum aestivum* L., and barley, *Hordeum vulgare* L., various cultivars
PEST: Cereal aphids: specifically the English grain aphid, *Sitobion avenae* (Fab)

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TITLE: **SURVEY OF PREDATORS AND PARASITOIDS OF CEREAL APHIDS IN SASKATCHEWAN WITH NOTES ON THE PRESENCE OF OTHER CROP PESTS**

METHODS: Cereal aphids in wheat and barley fields and their potential predators and parasitoids were collected and identified from four areas; Alvina, Medstead, Osler, and the AAFC Saskatoon Experimental Farm (SEF) (three fields per area) in Saskatchewan during the growing season of 2012. Other herbivores on cereal crops were also identified and enumerated. Two insect sampling methods were tested for their efficacy in determining insect numbers in the fields: whole plant and sweep netting. The whole plant method consisted of carefully bagging ten whole plants from each field to collect the insects that were feeding on them. Surrounding plants were gently pushed away, a plastic bag was slipped over the top of the selected plant, then bagged plants were cut at the base, placed in a cooler for transportation and stored in a laboratory freezer. The ten individual plants were taken along a transect starting from the field edge (0 m) into the field at ten m intervals at each site and sample date. Twenty sweep net samples per site and sample date were taken along two transects that paralleled the whole plant transect at ten m intervals. Insects were collected from the whole plants and the sweep bags, stored in 70% ethanol, and frozen until laboratory identification under a binocular microscope. Appropriate binomial keys were used where necessary to identify insects to species. Aphid mummies were counted and the percentage of parasitism was estimated as the number of aphid mummies/total number of aphids across all field sites. Mean numbers of insects caught by each sample method were analyzed with two-tailed t-tests for unequal variances.

RESULTS: All cereal aphid aphids encountered were *Sitobion avenae* (Fab) (Hemiptera: Aphididae) (Table 1). Aphid populations developed in three of the four sample areas in 2012 (Medstead, Osler and SEF). More aphids were captured from sweep nets surveys than whole plant surveys (Table 1). Overall, sweep netting proved to be the superior sample method and caught more of every insect species than the whole plant samples. The six spotted or aster leafhopper, *Macrosteles quadrilineatus* Forbes (Hemiptera: Cicadellidae) and adults of the seedcorn maggot, *Delia platura* (Meigen) (Diptera: Anthomyiidae), were found in sweep nets at all four areas across Saskatchewan. The main generalist predators were green lacewing larvae (Neuroptera: Crysopidae), lady beetle adults and larvae (Coleoptera: Coccinellidae), minute pirate bugs (Hemiptera: Anthocoriidae), and damsel bugs (Hemiptera: Nabidae).

The adults of two aphid parasitoids were identified: *Aphidius avenaphis* (Fitch) (Hymenoptera: Braconidae: Aphidiinae) and *Aphilinus varipes* (Foerster) (Hymenoptera: Chalcididoidea: Aphelinidae). Total parasitism rate based on the number of aphid mummies in 2012 compared to all aphids sampled was 7.6 % and sweep nets collected significantly more aphid mummies (Table 1). Some aphid mummies were dissected (~50%) and two had parasitoids in the pupal stage and were clearly braconids and not chalcids based on number of flagellar segments of the antennae. The other mummies dissected contained larval parasitoids. The morphology of most aphid mummies corresponded to parasitism by the braconid *Aphidius*. Adults of two species of hyper-parasitoids of *Aphidius* sp., *Asaphes suspensus* (Nees) and *Aphidencyrtus* sp. (Hymenoptera: Pteromalidae) were also captured in sweep nets samples.

CONCLUSIONS: Cereal aphids were represented by a monoculture of English grain aphids, *S. avenae*, parasitized at an overall rate of 7.6%. Sweep net sampling was superior to whole plant sampling for collecting aphids and their parasitized mummies and for identifying their predators and parasitoids. Without sweep net sampling the predator guild of cereal aphids would not have been visible except for two lady beetle specimens. Whole plant sampling recorded very few predators but was useful for detection of aphid mummies glued to the plant by the parasitoid larva and for quantifying the number of aphids per individual plant, which is useful for calculating economic thresholds. Sweep netting also captured other herbivores of note across all fields sampled such as six spotted leafhoppers and seedcorn maggot flies, while whole plant sampling revealed only one leafhopper and no flies. Knowledge obtained from this survey will be used to assess the impact of predators and parasitoids on cereal aphid population levels.

Table 1. Comparison of total insect numbers for whole plant and sweep net sampling techniques conducted in wheat and barley fields at three fields in four areas of Saskatchewan in 2012.

		Collection method	
Common names	Species	Whole plant	Sweep net
Herbivores			
aphids	*Sitobion avenae* (Fab)	255	2535
leafhoppers	*Macrosteles quadrilineatus* Forbes	1	598
	Athysanus argentarius (Metcalf)	0	11
seedcorn maggot	*Delia platura* (Meigen)	0	291
green grass bug	*Trigonotylus coelestialium* (Kirkaldy)	0	13
Herbivores	Two tailed t-test	t=1.69(29) p=0.059	
Generalist predators			
green lacewing (larvae)	*Chrysoperla carnea* (Stevens)	0	20
	Chrysopa oculata Say	0	4
lady beetles (adults and larvae)	*Coccinella septempunctata* (Linnaeus)	2	25
	Hippodamia tredecimpunctata Linnaeus	0	23
minute pirate bugs	*Orius tristicolor* (White)	0	2
damsel bugs	*Nabis* sp.	0	1
Aphid parasitoids			
	Aphidiius avenaphis (Fitch)	0	2
	Aphelinus varipes (Foerster)	0	6
	total predators + parasitoids	2	83
aphid mummies (parasitized)		30	183
Parasitoids and predators	Two tailed t-test	t=2.75(7) p=0.028	
aphid mummies	Two tailed t-test	t=2.20(11) p=0.022	
Hyper-parasitoids			
	Asaphes suspensus (Nees)	0	3
	Aphidencyrtus sp.	0	2

2012 PMR Report # 06 **SECTION K: FRUIT - Diseases**
STUDY DATA BASE: WBSE-E.1206.QM

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

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TITLE: EFFECT OF DIFFERENT FUNGICIDES ON THE CONTROL OF POSTHARVEST GRAY MOLD IN 'MCINTOSH' APPLES, 2011-12

MATERIALS: DIFENOCONAZOLE (23.4% difenoconazole), MERTECT (45 % Thiabendazole), PENBOTEC 400 SC (37.5% Pyrimethanil), PRISTINE (25.2% Boscalid and 12.8% Pyraclostrobin), SCHOLAR (Fludioxonil) and BIOSAVE (*Pseudomonas syringae*, ESC10)

METHODS: A trial was conducted to determine the effect of fungicides, SCHOLAR 50 WG, PENBOTEC 400 SC, DIFENOCONAZOLE, BIOSAVE, PRISTINE and MERTECT on the control of postharvest gray mold in wounded apples. Optimum harvest time for long- term storage for the apples was determined by the internal ethylene concentration and starch staining. 'McIntosh' Mac Spur apple fruits were harvested on October 6, 2011 and treated on 18 October, 2011. The treatments include, 5 fungicide treatments (SCHOLAR @ 0.6 g/L, PENBOTEC @ 1.16 g/L, DIFENOCONAZOLE @ 1.15 g/L, MERTECT @ 1.15 g/L, PRISTINE@ 0.5 g/L and a biocontrol, BIOSAVE @ 1.59 g/L,) and a control without any fungicide. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of TBZ and difenoconazole-resistant *B. cinerea* BC 34-R isolate at a concentration of 1 x 10^4 conidia/ml and incubated at 12 °C for 18-24 hours and then treated with fungicide treatments. Drench treatment included mixing of appropriate amount of fungicide concentration in water and pouring on to wounded and inoculated fruit for 30 seconds or until the fruit was completely drenched. The fruits were drained and placed in the storage crates. There were 3 replicates per treatment and 9 fruits in each of the replicate. The treatments were completely randomized. Treated apples were incubated at 3 to 4°C for up to 6 months. Apples in each of the experiments were evaluated for decay after the respective incubation periods. To determine the efficacy of fungicides on the shelf-life of the fruit, after first fruit decay evaluations following incubation in CA, the fruits were moved to 20 °C, 85% RH and incubated for 7 days. The fruits were again evaluated for blue mold incidence (percent infected apples). Fruits were considered decayed when a lesion is developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and the significance between means was separated by the Tukey test.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: The control had the highest gray mold incidence. The test fungicide treatments, SCHOLAR @ 0.6 g/L gave a complete control of gray mold for up to 6 months. PENBOTEC @ 1.16 g/L gave complete control for up to 5 months and PRISTINE @0.5 %, for up to 4 months. As expected, MERTECT was not effective against TBZ- and difenoconazole -resistant isolates of *Botrytis*. In case of BIOSAVE, a higher disease incidence was observed in the fruit suggesting it is not effective as a

curative treatment. With the exception of SCHOLAR, all the treatments had higher disease incidence in the shelf-life study after 6 months of storage in air at 0.5-2°C.

Table 1. Effect of different fungicides on the control of postharvest gray mold (*Botrytis cinerea*), in 'McIntosh' apples 2011-12.

	% Gray mold incidence in cold storage at 4℃[a]						Shelf – life Study at 20 ℃
Treatment	1 month	2 months	3 months	4 months	5 months	6 months	7 days
Control	100 e[b]	100 e	100 e	100 e	100 e	100 f	100 f
PRISTINE @ 0.5 g/L	0 a	0 a	0 a	0 a	22.2 b	25.9 c	34.4 c
SCHOLAR @ 0.6 g/L	0 a	0 a	0 a	0 a	0 a	0 a	0 a
PENBOTEC @ 1.16 g/L	0 a	0 a	0 a	0 a	0 a	11.1 b	14.8 b
MERTECT @ 1.15 g/L	81.5 d	88.9 d	88.9 d	88.9 d	88.9 d	88.9 e	92.6 e
BIOSAVE @ 1.59 g/L	59.3 c	81.5 c	81.5 c	81.5 c	81.5 c	81.5 d	85.2 d
DIFENOCON-AZOLE @ 1.15 g/L	55.5 b	70.4 b	74.1 b	74.1 b	85.2 c	88.9 e	92.6 e

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

2012 PMR Report # 07 **SECTION K: FRUIT - Diseases**
STUDY DATA BASE: WBSE-E.1206.QM

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

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TITLE: EFFECT OF DIFFERENT FUNGICIDES ON THE CONTROL OF POSTHARVEST BLUE MOLD IN 'MCINTOSH' APPLES, 2011-12

MATERIALS: DIFENOCONAZOLE (23.4% difenoconazole), MERTECT (45 % Thiabendazole), PENBOTEC 400 SC (37.5% Pyrimethanil), PRISTINE (25.2% Boscalid and 12.8% Pyraclostrobin), SCHOLAR (45% Fludioxonil) and BIOSAVE (*Pseudomonas syringae*, ESC10)

METHODS: A trial was conducted to determine the effect of fungicides, SCHOLAR, PENBOTEC, DIFENOCONAZOLE, BIOSAVE, PRISTINE and MERTECT on the control of postharvest gray mold in wounded apples. Optimum harvest time for long- term storage for the apples was determined by the internal ethylene concentration and starch staining. 'McIntosh' MacSpur apple fruits were harvested on October 6, 2011 from an orchard at the Agriculture and Agri-Food Canada research Farm at Jordan Station, Ontario. All fruits were stored at 1 – 4 °C until used in experimental treatments. The apples were treated on 18 October, 2011.The treatments include, 5 fungicide treatments (SCHOLAR @ 0.6 g/L, PENBOTEC @ 1.16 g/L, DIFENOCONAZOLE @ 1.15 g/L, MERTECT @ 1.15 g/L, PRISTINE@ 0.5 g/L and a biocontrol, BIOSAVE @ 1.59 g/L,) and a control without any fungicide.The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of TBZ -resistant *Penicillium expansum* PS-1R isolate at a concentration of 1 x 10^4 conidia/ml and incubated at 12 °C for 18-24 hours and then treated with fungicide treatments. Drench treatment included mixing of appropriate amount of fungicide concentration in water and pouring on to wounded and inoculated fruit for 30 seconds or until the fruit was completely drenched. The fruits were drained and placed in the storage crates. There were 3 replicates per treatment and 9 fruits in each of the replicate. The treatments were completely randomized. Treated apples were incubated at 3 to 4°C for up to 6 months. Apples in each of the experiments were evaluated for decay after the respective incubation periods. To determine the efficacy of fungicides on the shelf-life of the fruit, after first fruit decay evaluations following incubation in controlled atmosphere, CA, the fruits were moved to 20 °C, 85% RH and incubated for 7 days. The fruits were again evaluated for blue mold incidence (percent infected apples). Fruits were considered decayed when a lesion is developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and the significance between means was separated by the Tukey test.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: The control had the highest blue mold incidence. The test fungicide treatments, SCHOLAR @ 0.6 g/L and PENBOTEC @ 1.16 g/L gave complete control of blue mold for up to 6 months and PRISTINE @0.5 %, for up to 5months. As Expected, MERTECT was not effective against TBZ -resistant isolate of *Penicillium*. In case of BIOSAVE, a higher disease incidence was observed in the fruit suggesting that it is not effective against blue mold as a curative treatment. With the exception of SCHOLAR, all the treatments had higher disease incidence in the shelf-life study after 6 months of storage in air at 0.5-2°C.

Table 1. Effect of different fungicides on the control of postharvest blue mold (*Penicillium expansum*) in 'McIntosh' apples, 2011-12.

	% Blue mold incidence in cold storage at 4℃[a]						Shelf – life Study at 20 ℃
Treatment	1 month	2 months	3 months	4 months	5 months	6 months	7 days
Control	85.2 d[b]	92.6 d	96.3 d	100 d	100 d	100 e	100 f
PRISTINE @ 0.5 g/L	0 a	0 a	0 a	0 a	0 a	29.6 c	33.3 d
SCHOLAR @ 0.6 g/L	0 a	0 a	0 a	0 a	0 a	0 a	3.7 a
PENBOTEC @ 1.16 g/L	0 a	0 a	0 a	0 a	0 a	0 a	14.8 b
MERTECT @ 1.15 g/L	88.9 e	100 e	100 e	100 d	100 d	100 e	100 f
BIOSAVE @ 1.59 g/L	70.4 c	85.2	88.9 c	88.9 c	96.3 c	96.3 d	96.3 e
DIFENOCON-AZOLE @ 1.15 g/L	7.4 b	14.8 b	18.5 b	18.5 b	18.5 b	25.9 b	29.6 c

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

[b]Data represent the mean of three replicates.

2012 PMR Report # 08 **SECTION K: FRUIT - Diseases**
STUDY DATA BASE: WBSE-E.1206.QM

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

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TITLE: EFFECT OF DIFFERENT FUNGICIDES ON THE CONTROL OF POSTHARVEST BLUE MOLD IN 'AMBROSIA' APPLES, 2011-12.

MATERIALS: DIFENOCONAZOLE (23.4% Difenoconazole), MERTECT (45% Thiabendazole), PENBOTEC 400 SC (37.5% Pyrimethanil), PRISTINE (25.2% Boscalid and 12.8% Pyraclostrobin), SCHOLAR (45% Fludioxonil) and BIOSAVE (*Pseudomonas syringae*, ESC10)

METHODS: A trial was conducted to determine the effect of fungicides, SCHOLAR 50, PENBOTEC, DIFENOCONAZOLE, BIOSAVE, PRISTINE and MERTECT on the control of postharvest gray mold in wounded apples. Optimum harvest time for long- term storage for the apples was determined by the internal ethylene concentration and starch staining. 'Ambrosia' apple fruits were harvested on October 6, 2011 from an orchard at the Agriculture and Agri-Food Canada research Farm at Jordan Station, Ontario. All fruits were stored at 1 – 4 °C until used in experimental treatments. The apples were treated on 24 October, 2011. The treatments include, 5 fungicide treatments (SCHOLAR @ 0.6 g/L, PENBOTEC @ 1.16 g/L, DIFENOCONAZOLE @ 1.15 g/L, MERTECT @ 1.15 g/L, PRISTINE@ 0.5 g/L and a biocontrol, BIOSAVE @ 1.59 g/L,) and a control without any fungicide.The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of TBZ -resistant *Penicillium expansum* PS-1R isolate at a concentration of 1×10^4 conidia/ml and incubated at 12 °C for 18-24 hours and then treated with fungicide treatments. Drench treatment included mixing of appropriate amount of fungicide concentration in water and pouring on to wounded and inoculated fruit for 30 seconds or until the fruit was completely drenched. The fruits were drained and placed in the storage crates. There were 3 replicates per treatment and 9 fruits in each of the replicate. The treatments were completely randomized. Treated apples were incubated at 3 to 4°C for up to 6 months. Apples in each of the experiments were evaluated for decay after the respective incubation periods. To determine the efficacy of fungicides on the shelf-life of the fruit, after first fruit decay evaluations following incubation in controlled atmosphere, CA, the fruits were moved to 20 °C, 85% RH and incubated for 7 days. The fruits were again evaluated for blue mold incidence (percent infected apples). Fruits were considered decayed when a lesion is developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and the significance between means was separated by the Tukey test.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: The control had the highest blue mold incidence. The test fungicide treatments, SCHOLAR @ 0.6 g/L and PENBOTEC @ 1.16 g/L gave complete control of blue mold for up to 6 months and PRISTINE @0.5 %, for up to 5 months. As Expected, MERTECT was not effective against TBZ--resistant isolate of *Penicillium*. In case of BIOSAVE, a higher disease incidence was observed in the fruit suggesting that it is not effective against blue mold as a curative treatment. With the exception of SCHOLAR, all the treatments had higher than 10.0% blue mold disease incidence in the shelf-life study after 6 months of storage in air at 0.5-2°C.

Table 1. Effect of different fungicides on the control of postharvest blue mold (Penicillium expansum) in 'McIntosh' apples, 2011-12.

	% Blue mold incidence in cold storage at 4℃[a]						Shelf – life Study at 20 ℃
Treatment	1 month	2 months	3 months	4 months	5 months	6 months	7 days
Control	77.7 e[b]	85.2 e	85.2 e	88.9 d	88.9 d	88.9 c	96.3 d
PRISTINE @ 0.5 g/L	0 a	0 a	0 a	0 a	0 a	11.1 b	11.1 b
SCHOLAR @ 0.6 g/L	0 a	0 a	0 a	0 a	0 a	0 a	0 a
PENBOTEC @ 1.16 g/L	0 a	0 a	0 a	0 a	0 a	0 a	14.8 c
MERTECT @ 1.15 g/L	66.6 d	77.8 d	81.5 d	81.5 c	81.5 c	88.9 c	96.3 d
BIOSAVE @ 1.59 g/L	22.2 c	74.1 c	77.8 c	88.9 d	96.3 e	100 d	100 e
DIFENOCON-AZOLE @ 1.15 g/L	7.4 b	7.4 b	11.1 b	11.1 b	11.1 b	11.1 b	11.1 b

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

2012 PMR Report # 09 **SECTION K: FRUIT - Diseases**
STUDY DATA BASE: WBSE-E.1206.QM

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

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TITLE: EFFECT OF DIFFERENT FUNGICIDES ON THE CONTROL OF POSTHARVEST GRAY MOLD IN 'AMBROSIA' APPLES, 2011-12

MATERIALS: DIFENOCONAZOLE (23.4% Difenoconazole), MERTECT (45 % Thiabendazole), PENBOTEC 400 SC (37.5% Pyrimethanil), PRISTINE (25.2% Boscalid and 12.8% Pyraclostrobin), SCHOLAR (45% Fludioxonil) and BIOSAVE (*Pseudomonas syringae*, ESC10).

METHODS: A trial was conducted to determine the effect of fungicides, SCHOLAR, PENBOTEC, DIFENOCONAZOLE, BIOSAVE, PRISTINE and MERTECT on the control of postharvest gray mold in wounded apples. Optimum harvest time for long- term storage for the apples was determined by the internal ethylene concentration and starch staining. 'Ambrosia' apple fruits were harvested on October 6, 2011 from an orchard at the Agriculture and Agri-Food Canada research Farm at Jordan Station, Ontario. All fruits were stored at 1 – 4 °C until used in experimental treatments. The apples were treated on 24 October, 2011. The treatments include, 5 fungicide treatments (SCHOLAR @ 0.6 g/L, PENBOTEC @ 1.16 g/L, DIFENOCONAZOLE @ 1.15 g/L, MERTECT @ 1.15 g/L, PRISTINE@ 0.5 g/L and a biocontrol, BIOSAVE @ 1.59 g/L,) and a control without any fungicide.The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of TBZ and difenoconazole-resistant *B. cinerea* BC 34-R isolate at a concentration of 1 $x10^4$ conidia/ml and incubate at 12 °C for 18-24 hours and then treated with fungicide treatments. Drench treatment included mixing of appropriate amount of fungicide concentration in water and pouring on to wounded and inoculated fruit for 30 seconds or until the fruit was completely drenched. The fruits were drained and placed in the storage crates. There were 3 replicates per treatment and 9 fruits in each of the replicate. The treatments were completely randomized. Treated apples were incubated at 3 to 4°C for up to 6 months. Apples in each of the experiments were evaluated for decay after the respective incubation periods. To determine the efficacy of fungicides on the shelf-life of the fruit, after first fruit decay evaluations following incubation in controlled atmosphere, CA, the fruits were moved to 20 °C, 85% RH and incubated for 7 days. The fruits were again evaluated for blue mold incidence (percent infected apples). Fruits were considered decayed when a lesion is developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and the significance between means was separated by the Tukey test.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: The control had the highest gray mold incidence. The test fungicide treatments, SCHOLAR @ 0.6 g/L gave a complete control of gray mold all through the study, for up to 6 months. PENBOTEC @ 1.16 g/L and PRISTINE@ 0.5 g/L gave complete control for up to 5 months. As expected, MERTECT and DIFENOCONAZOLE were not effective against TBZ- and difenoconazole - resistant isolates of *Botrytis*. In case of BIOSAVE, a higher disease incidence was observed in the fruit suggesting it is not effective as a curative treatment. With the exception of SCHOLAR, all the treatments had higher disease incidence in the shelf-life study after 6 months of storage in air at 0.5-2°C.

Table 1. Effect of different fungicides on the control of postharvest gray mold (Botrytis cinerea) in 'Ambrosia' apples, 2011-12.

	% Gray mold incidence in cold storage at 4℃a						Shelf – life Study at 20 ℃
Treatment	1 month	2 months	3 months	4 months	5 months	6 months	7 days
Control	66.7db	66.7 d	70.4d	74.1 d	74.1e	74.1f	88.9 f
PRISTINE @ 0.5 g/L	0 a	0 a	0 a	0 a	0 a	11.1 b	33.3 c
SCHOLAR @ 0.6 g/L	0 a	0 a	0 a	0 a	0 a	0 a	0 a
PENBOTEC @ 1.16 g/L	0 a	0 a	0 a	0 a	0 a	11.1 b	14.8 b
MERTECT @ 1.15 g/L	59.2 e	66.7 d	66.7 d	66.7 d	66.7 c	66.7 d	70.4 d
BIOSAVE @ 1.59 g/L	14.8 b	37 c	59.3 c	63 c	70.4 d	70.4 e	74.1 e
DIFENOCON-AZOLE @ 1.15 g/L	18.5 c	29.6 b	29.6 b	29.6 b	29.6 b	29.6 c	33.3 c

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

2012 PMR Report # 10 **SECTION K: FRUIT - Diseases**
STUDY DATA BASE: WBSE-E.1206.QM

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

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TITLE: EFFECT OF DIFFERENT FUNGICIDES ON THE CONTROL OF POSTHARVEST BLUE MOLD IN 'FUJI' APPLES, 2011-12

MATERIALS: DIFENOCONAZOLE (23.4% Difenoconazole), MERTECT (45% Thiabendazole), PENBOTEC 400 SC (37.5% Pyrimethanil), PRISTINE (25.2% Boscalid and 12.8% Pyraclostrobin), SCHOLAR (45% Fludioxonil) and BIOSAVE (*Pseudomonas syringae*, ESC10)

METHODS: A trial was conducted to determine the effect of fungicides, SCHOLAR, PENBOTEC, DIFENOCONAZOLE, BIOSAVE, PRISTINE and MERTECT on the control of postharvest gray mold in wounded apples. Optimum harvest time for long- term storage for the apples was determined by the internal ethylene concentration and starch staining. 'Fuji' apple fruits were harvested on October 6, 2011 from an orchard at the Agriculture and Agri-Food Canada research Farm at Jordan Station, Ontario. All fruits were stored at 1 – 4 °C until used in experimental treatments. The apples were treated on 24 October, 2011. The treatments include, 5 fungicide treatments (SCHOLAR @ 0.6 g/L, PENBOTEC @ 1.16 g/L, DIFENOCONAZOLE @ 1.15 g/L, MERTECT @ 1.15 g/L, PRISTINE@ 0.5 g/L and a biocontrol, BIOSAVE @ 1.59 g/L,) and a control without any fungicide. The apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of TBZ -resistant *Penicillium expansum* PS-1R isolate at a concentration of 1 x 10^4 conidia/ml and incubated at 12 °C for 18-24 hours and then treated with fungicide treatments. Drench treatment included mixing of appropriate amount of fungicide concentration in water and pouring on to wounded and inoculated fruit for 30 seconds or until the fruit was completely drenched. The fruits were drained and placed in the storage crates. There were 3 replicates per treatment and 9 fruits in each of the replicate. The treatments were completely randomized. Treated apples were incubated at 3 to 4°C for up to 6 months. Apples in each of the experiments were evaluated for decay after the respective incubation periods. To determine the efficacy of fungicides on the shelf-life of the fruit, after first fruit decay evaluations following incubation in controlled atmosphere, CA, the fruits were moved to 20 °C, 85% RH and incubated for 7 days. The fruits were again evaluated for blue mold incidence (percent infected apples). Fruits were considered decayed when a lesion is developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and the significance between means was separated by the Tukey test.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: The control had the highest blue mold incidence. The test fungicide treatments, SCHOLAR @ 0.6 g/L, DIFENOCONAZOLE @ 1.15 g/L and PENBOTEC @ 1.16 g/L gave complete control of blue mold for up to 6 months and PRISTINE @0.5 %, for up to 5 months. As expected, MERTECT was not effective against TBZ -resistant isolate of *Penicillium*. In case of BIOSAVE, it gave 94% control for up to one month and a higher disease incidence was observed in the subsequent months. With the exception of SCHOLAR, all the treatments had higher than 10.0% blue mold disease incidence in the shelf-life study after 6 months of storage in air at 0.5-2°C.

Table 1. . Effect of different fungicides on the control of postharvest blue mold (*Penicillium expansum*) in 'Fuji' apples, 2011-12.

	% Gray mold incidence in cold storage at 4℃a						Shelf – life Study at 20 ℃
Treatment	1 month	2 months	3 months	4 months	5 months	6 months	7 days
Control	96.3 db	96.3 d	96.3 d	96.3 d	100 d	100 e	100 d
PRISTINE @ 0.5 g/L	0 a	0 a	0 a	0 a	0 a	11.1 b	11.1 b
SCHOLAR @ 0.6 g/L	0 a	0 a	0 a	0 a	0 a	0 a	0 a
PENBOTEC @ 1.16 g/L	0 a	0 a	0 a	0 a	0 a	0 a	14.8 c
MERTECT @ 1.15 g/L	81.4 c	88.9 c	88.9 c	88.9 c	88.9 c	88.9 d	88.9 c
BIOSAVE @ 1.59 g/L	7.4 b	29.6 b	40.7 b	55.6 b	70.4 b	70.4 c	88.9 c
DIFENOCON-AZOLE @ 1.15 g/L	0 a	0 a	0 a	0 a	0 a	0 a	11.1 b

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

2012 PMR Report # 11 **SECTION K: FRUIT - Diseases**
STUDY DATA BASE: WBSE-E.1206.QM

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

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TITLE: EFFECT OF DIFFERENT FUNGICIDES ON THE CONTROL OF POSTHARVEST GRAY MOLD IN 'FUJI' APPLES, 2011-12

MATERIALS: DIFENOCONAZOLE (23.4% Difenoconazole), MERTECT (45 % Thiabendazole), PENBOTEC 400 SC (37.5% Pyrimethanil), PRISTINE (25.2% Boscalid and 12.8% Pyraclostrobin), SCHOLAR (45% Fludioxonil) and BIOSAVE (*Pseudomonas syringae*, ESC10).

METHODS: A trial was conducted to determine the effect of fungicides, SCHOLAR, PENBOTEC, DIFENOCONAZOLE, BIOSAVE, PRISTINE and MERTECT on the control of postharvest gray mold in wounded apples. Optimum harvest time for long- term storage for the apples was determined by the internal ethylene concentration and starch staining. 'Fuji' apple fruits were harvested on October 6, 2011 from an orchard at the Agriculture and Agri-Food Canada research Farm at Jordan Station, Ontario. All fruits were stored at 1 – 4 °C until used in experimental treatments. The apples were treated on 24 October, 2011. The treatments include, 5 fungicide treatments (SCHOLAR @ 0.6 g/L, PENBOTEC @ 1.16 g/L, DIFENOCONAZOLE @ 1.15 g/L, MERTECT @ 1.15 g/L, PRISTINE@ 0.5 g/L and a biocontrol, BIOSAVE @ 1.59 g/L,) and a control without any fungicideThe apples were punctured once with a nail-like probe (5 mm diam.) to a depth of 4 mm. Within 45 minutes of wounding, apples were inoculated with a 20 µl drop of TBZ-resistant *B. cinerea* BC 34-R isolate at a concentration of 1 $x10^4$ conidia/ml and incubate at 12 °C for 18-24 hours and then treated with fungicide treatments. Drench treatment included mixing of appropriate amount of fungicide concentration in water and pouring on to wounded and inoculated fruit for 30 seconds or until the fruit was completely drenched. The fruits were drained and placed in the storage crates. There were 3 replicates per treatment and 9 fruits in each of the replicate. The treatments were completely randomized. Treated apples were incubated at 3 to 4°C for up to 6 months. Apples in each of the experiments were evaluated for decay after the respective incubation periods. To determine the efficacy of fungicides on the shelf-life of the fruit, after first fruit decay evaluations following incubation in controlled atmosphere, CA, the fruits were moved to 20 °C, 85% RH and incubated for 7 days. The fruits were again evaluated for blue mold incidence (percent infected apples). Fruits were considered decayed when a lesion is developed on the fruit. The data obtained were analyzed by analysis of variance using appropriate transformations and the significance between means was separated by the Tukey test.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: The control had the highest gray mold incidence. The test fungicide treatments, SCHOLAR @ 0.6 g/L and PENBOTEC @ 1.16 g/L gave a complete control of gray mold, all through the study, for up to 6 months. PRISTINE@ 0.5 g/L gave complete control for up to 5 months. As expected, MERTECT was not effective against TBZ- resistant isolate of *Botrytis*. In case of BIOSAVE and DIFENOCONAZOLE, complete control was observed for up to 60 days after inoculation and a higher disease incidence was observed in the fruit in the subsequent months. With the exception of SCHOLAR, all the treatments had higher disease incidence in the shelf-life study after 6 months of storage in air at 0.5-2°C.

Table 1. Effect of different fungicides on the control of postharvest gray mold (*Botrytis cinerea*) in 'Fuji' apples 2011-12.

	% Gray mold incidence in cold storage at 4℃a						Shelf – life Study at 20 ℃
Treatment	1 month	2 months	3 months	4 months	5 months	6 months	7 days
Control	66.7c[b]	66.7 c	70.4 d	74.1 e	74.1 e	74.1e	88.9 g
PRISTINE @ 0.5 g/L	0 a	0 a	0 a	0 a	0 a	11.1 b	11.1 b
SCHOLAR @ 0.6 g/L	0 a	0 a	0 a	0 a	0 a	0 a	0 a
PENBOTEC @ 1.16 g/L	0 a	0 a	0 a	0 a	0 a	0 a	25.9 d
MERTECT @ 1.15 g/L	44.4 b	44.4 b	44.4 d	55.6 d	55.6 d	55.6 d	55.6 f
BIOSAVE @ 1.59 g/L	0 a	0 a	18.5 c	18.5 c	22.2 c	29.6 c	29.6 e
DIFENOCON-AZOLE @ 1.15 g/L	0 a	0 a	14.8 b	14.8 b	18.5 b	22.2 b	22.2 c

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

2012 PMR REPORT# 12 **SECTION L: VEGETABLES and SPECIAL CROPS - Diseases**

CROP: Yellow cooking onions (*Allium cepa* L.), cv. Countach
PEST: Onion smut (*Urocystis colchici* var. *cepulae* Cooke)

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TITLE: **EVALUATION OF FUNGICIDE SEED TREATMENTS FOR CONTROL OF ONION SMUT IN YELLOW COOKING ONIONS, 2012**

MATERIALS: ALLLEGIANCE (metalaxyl 28.4%), RANCONA (ipconazole 41%), DITHANE (mancozeb 75%), PRO-GRO (thiram 50%, carboxin 30%), SEPRESTO (clothianidin 56.25%, imidacloprid 18.75%), PENFLUFEN FS 50 (penflufen 4.81%)

METHODS: Seed treatments for yellow cooking onions, cv. Countach, were evaluated in a field trial on organic soil (pH ≈ 5.8, organic matter ≈ 78.6%) naturally infested with *Urocystis colchici* at the Muck Crops Research Station, Holland Marsh, Ontario. Treatments were the following chemicals used alone and in combination: DITHANE at 8.8 kg/ha, PRO-GRO at 0.5, 1.0 and 2.0 g ai/100 g seed, RANCONA at 100, 50 mg ai/100 g seed and PENFLUFEN at 250 mg ai/100g seed. An untreated check was also included. DITHANE was applied using a push V-belt seeder at a rate of 0.35 g/m. All seeds were treated with SEPRESTO (insecticide) at 6.57 g ai/100 g seed. Seeds were treated at Cornell University by Al Taylor. Treatments were replicated four times in a randomized complete block design. Each experimental unit consisted of four rows (42 cm apart), 5 m in length. All seed treatments were seeded on 7 May using a push-cone seeder. Three random 2 m sections were staked out, and germination counts were conducted on 31 May to determine initial stands prior to the first assessment. Plants were examined for onion smut (OS) or damage caused by other pests within the staked-out sections on a weekly basis throughout June and July. Damaged plants were rogued out and the cause recorded. At one (12 June), and three (25 June) true leaf stage, one of the 2 m sections was harvested and bulbs and leaves were visually evaluated for OS. On 20 September a 2.33 m section was harvested and on 17 November the bulbs were removed from storage, counted, and weighed to determine yield. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.9. Means separation was obtained by using Fisher's Protected LSD test at $P = 0.05$ level of significance.

RESULTS: as presented in Table 1

CONCLUSIONS: Significant differences were found in percent onion smut at the 1st and 3rd leaf stages (Table 1). At the 1st leaf stage, RANCONA at any rate alone or in combination with PENFLUFEN or PRO-GRO had lower OS losses than all other treatments. At the 3rd leaf stage, onions grown from seeds treated with PENFLUFEN or RANCONA+PENFLUFEN had significantly fewer OS losses than onions grown using PRO-GRO alone or the untreated check.
The addition of PRO-GRO to RANCONA as a seed treatment did not improve OS control and this may indicate that PRO-GRO interferes with RANCONA.
Significant differences were found among the treatments in weight per bulb and tonnes/ha. Treatments with high losses from smut (>20%) in the 1st and 3rd leaf had lower yields and higher weight/bulb. As the stand in thinned onions tend to have more room to grow resulting in larger onions. Onions treated with PENFLUFEN or PENFLUFEN+RANCONA had significantly higher yields than the PRO-GRO+DITHANE and PRO-GRO alone treatment.

ACKNOWEDGEMENT: Funding for this project was supplied by Chemtura and the OMAFRA/University of Guelph Sustainable Production Systems Program. The New York State Agricultural Experiment Station, Cornell University provided support for seed treatment application of new chemistry seed treatments. Any opinions, findings, conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of Cornell University or those of Rutgers, State University of New Jersey.

Table 1. Percent onion smut (OS) for onions, cv. Countach, grown from seeds treated with various fungicides at Muck Crops Research Station, Holland Marsh, Ontario, 2012

Treatment	Rate (mg ai/100 g of seed)	% OS Losses within 2 m sections		Yield	
		1st Leaf	3rd Leaf	Wgt/Bulb (g)	t/ha
RANCONA + PENFLUFEN[1]	100 + 250	3.7 a[2]	2.6 a	113 d	70.2 ab
PENFLUFEN	250	2.6 a	5.1 a	113 d	77.6 a
RANCONA + PRO-GRO	100 + 500	5.2 a	9.1 ab	108 d	65.5 abc
RANCONA + PRO-GRO	100 + 1,000	1.2 a	9.0 ab	116 cd	56.8 bcd
RANCONA	50	4.8 a	10.0 ab	133 bcd	65.8 abc
RANCONA	100	4.8 a	15.3 abc	130 bcd	51.5 bcd
PRO-GRO + DITHANE	2,000 + 8.8 kg/ha	30.3 b	20.9 cd	144 abc	42.8 d
DITHANE	8.8 kg/ha	48.2 c	25.9 cd	162 a	58.0 a-d
PRO-GRO	2,000	37.4 bc	28.3 d	145 ab	47.9 cd
check		35.1 bc	30.4 d	150 ab	60.5 a-d

[1] All treatments also include Allegiance + Sepresto at 30mg ai/100 g of seed + 6.57 g ai/ 100 g of seed, respectively.
[2] Numbers in a column followed by the same letter are not significantly different at $P = 0.05$, Fisher's protected LSD Test.

2012 PMR REPORT # 13 **SECTION L: VEGETABLE and SPECIAL CROPS – Diseases**

CROP: Yellow cooking onions (*Allium cepa* L.), cv. La Salle
PEST: *Stemphylium vesicarium* (Wallr.)

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TITLE: EVALUATION OF FUNGICIDES FOR CONTROL OF STEMPHYLIUM LEAF BLIGHT IN ONIONS, 2012

MATERIALS: PRISTINE® (pyraclostrobin 25.2%, boscalid 12.8%), BRAVO® 500 (chlorothalonil 50%), MANZATE® 750 F (mancozeb 75%), SWITCH® 62.5 WG (cyprodinil 37.5%, fluodioxinil 25.0%), FONTELIS® 20 SC (penthiopyrad 20%), INSPIRE® (difenoconzole 23.2%), LUNA TRANQUILITY® (fluopyram 11.3%, pyrimethanil 33.8%), QUADRIS TOP (azoxystrobin 18.2%, difenoconazole 11.4%)

METHODS: Onion, cv. La Salle, was direct seeded (34 seeds/m) using a Stanhay Precision Seeder on 2 May into organic soil (organic matter ≈ 58%, pH ≈ 7.2) near the Muck Crops Research Station, Holland Marsh, Ontario. A randomized complete block arrangement with four replicates per treatment was used. Each experimental unit consisted of four rows, 42 cm apart, 5 m in length. Recommended control procedures for weeds and insects were followed. Treatments were: PRISTINE at 1.3 kg/ha, BRAVO 500 at 4.8 kg/ha, MANZATE 750 F at 3.25 kg/ha, SWITCH 62.5 WG at 975 g/ha, FONTELIS 20 SC at 1.4 L/ha, INSPIRE at 512 mL/ha, QUADRIS TOP at 1 L/ha and LUNA TRANQUILITY at 1.2 L/ha. An untreated check was also included. Treatments were applied on 12, 20 and 27 July, and 7 and 17 August using a CO_2 backpack sprayer equipped with four TeeJet 8002 VS fan nozzles spaced 40 cm apart and calibrated to deliver 400 L/ha at 240 kPa (boom). Experimental plots were assessed on 20 and 27 July, 7 and 17 August, and rated for stemphylium leaf blight using a 0-9 scale, where: 0 = 0%, 1 < 2%, 2 = 2-4%, 3 = 5-9%, 4 = 10-24%, 5 = 25-40 %, 6 = 41-55%, 7 = 56-70%, 8 = 71-85% and 9 > 85% foliar area diseased per plot. These values were used to calculate area under the disease progress curve (AUDPC) using the following equation:

$$\text{AUDPC} = \sum_{j=1}^{Nj-1} \left(\frac{y_j + y_{j+1}}{2}\right)(t_{j+1} - t_j)$$

Where j is the order index for the times and n_j is the total number of assessments, y_j is the rating for foliar area diseased per plot at day t_j, y_{j+1} is the rating for foliar area diseased per plot at day t_{j+1} and (t_{j+1} - t_j) is the number of days between two assessments.
On 20 August, ten plants from each replicate were pulled and assessed for percent of foliage infected. On 2 October, onions in two 2.32 m sections of row from each replicate were pulled for a yield sample. The onions were weighed and graded for size on 25 October.

Compared to the averaged previous 10 years, the air temperatures in 2012 were average for August (20.1ºC) and September (14.8ºC), and above average for May (15.9ºC), June (20.1ºC) and July (22.2ºC). The long term previous 10 year average temperatures were: May 12.3ºC, June 18.2ºC, July 20.7ºC, August 19.5ºC and September 15.8ºC. Monthly rainfall was below the previous long term 10 year average for May (49 mm) and June (55 mm), average for August (69 mm), and above average for July (140 mm) and September (94 mm). The long term previous 10 year rainfall averages were: May 77 mm, June 74 mm, July 81 mm, August 67 mm and September 74 mm.
Data were analysed using the General Analysis of Variance function of the Linear Models section of Statistix V.9. Means separation was obtained using Fisher's Protected LSD test with $P = 0.05$ level of significance.

RESULTS: as outlined in Tables 1 and 2.

CONCLUSIONS: In 2012, disease pressure was moderate. Stemphylium leaf blight started to develop in mid to late June in the Holland Marsh. Significant differences in stemphylium leaf blight severity were found among the treatments. All of the fungicides reduced disease compared to the untreated check. QUADRIS TOP, LUNA TRANQUILITY, INSPIRE and FONTELIS were most effective in reducing stemphylium leaf blight with 12, 12.8, 16.8 and 18.9% foliage with symptoms respectively, as compared to 33% in the untreated control (Table 1). Significant differences among the treatments in disease severity rating and area under the disease progress curve (AUDPC) were observed. The AUDPC was lower in QUADRIS TOP treated plots than the other treatments (Table 1). No differences in marketable yield or size distribution were found among the treatments (Table 2). However, reduced marketable yield was correlated ($r = -0.5$; $P = 0.002$) with percent total leaf length with stemphylium leaf blight symptoms. The percent of small onions (culls) also increased ($r = 0.39$; $P = 0.02$) with an increase in leaf length with disease symptoms. This indicates that fungicides which are registered for onion diseases can reduce stemphylium leaf blight and registration of the new materials can improve control. Incorporating the most effective fungicides into the integrated management of stemphylium leaf blight can reduce disease incidence and severity. All the products tested were non-phytotoxic to the crop.

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Table 1. Disease ratings for stemphyllium leaf blight symptoms of onions, cv. La Salle, treated with various fungicides, grown near the Muck Crops Research Station, Holland Marsh, Ontario, 2012.

Treatment	Rate (per ha)	% Total Leaf Length with Symptoms	Plot Rating			AUDPC[1]
			July 27	Aug 7	Aug 17	
QUADRIS TOP	1.0 L	12.0 a[2]	1.0 a	1.8 a	2.3 a	43.5 a
LUNA TRANQUILITY	1.2 L	12.8 ab	1.5 ab	2.3 abc	2.8 ab	57.1 bc
INSPIRE	512 mL	16.8 abc	1.8 ab	2.8 bcd	3.8 cd	70.8 cd
FONTELIS	1.4 L	18.9 bcd	1.5 ab	2.0 ab	3.3 bc	56.9 bc
PRISTINE	1.3 kg	19.8 cd	1.5 ab	2.5 abc	4.0 cde	67.0 cd
MANZATE	3.25 kg	20.1 cd	2.0 b	2.8 bcd	4.8 e	78.3 de
SWITCH	975 g	23.1 d	2.0 b	3.0 cd	4.3 de	78.5 de
BRAVO	4.8 kg	23.4 d	1.5 ab	2.5 bcd	3.8 cd	65.8 cd
Check	--	33.0 e	2.0 b	3.5 d	6.3 f	94.0 e

[1]AUDPC = area under the disease progress curve.
[2] Numbers in a column followed by the same letter are not significantly different at $P = 0.05$, Fisher's Protected LSD test.

Table 2. Comparison of marketable yield and size distribution of onions, cv. La Salle, treated with various fungicides grown near the Muck Crops Research Station, Holland Marsh, Ontario, 2012.

Treatment	Rate (per ha)	Marketable Yield (t/ha)	Size Distribution			
			% Jumbo (> 76 mm)	% Large (64 - 76 mm)	% Medium (45 - 64 mm)	% Cull (< 45 mm)
QUADRIS TOP	1.0 L	56.5 ns[1]	0.04 ns[1]	12.4 ns	75.7 ns	11.7 ns
LUNA TRANQUILITY	1.2 L	31.9	0.10	13.9	70.0	15.4
PRISTINE	1.3 kg	50.0	0.00	13.7	73.8	12.6
BRAVO	4.8 kg	49.1	0.03	9.2	78.3	12.2
MANZATE	3.25 kg	48.7	0.00	10.6	73.7	15.7
SWITCH	975 g	48.7	0.00	8.6	75.2	16.2
FONTELIS	1.4 L	47.9	0.00	13.6	69.6	16.8
INSPIRE	512 mL	46.8	0.03	10.6	71.9	17.2
Check	--	40.7	0.00	4.0	76.4	19.6

[1] Not significantly different at $P = 0.05$, Fisher's Protected LSD test.

2012 PMR REPORT# 14 SECTION O: CEREALS, FORAGE CROPS AND OILSEEDS -Diseases

CROP: Barley (*Hordeum vulgare L.*), cvs. Newdale, AC Metcalfe and Harrington
PEST: Net blotch net form, spot form (*Pyrenophora teres Drechs*.), Spot blotch (*Cochliobolus sativus*)

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TITLE: EFFECT OF FUNGICIDE ON LEAF SPOT DISEASES AND YIELD OF NEWDALE, AC METCALFE and HARRINGTON BARLEY AT MELFORT, 2012

MATERIALS: Check, TILT 250E (propiconazole 125 g. ai/ha) and PROLINE 480 SC (prothioconazole 149 g. ai/ha).

METHODS: Barley varieties Newdale, AC Metcalfe and Harrington all 2 row malt were chosen for their resistance or susceptibility to leaf spot diseases. Newdale was considered the most resistant variety and listed as fair/good/fair for net-form of net blotch, spot-form of net blotch and spot blotch, respectively (Saskatchewan Variety of Grain Crops 2012 Guide); AC Metcalfe is rated very poor/fair/fair while Harrington is susceptible (poor) to all. Varieties were direct seeded into canola stubble on May 14th using an Edwards hoe drill with an 8 inch row spacing. Fertilizer was applied following soil test recommendations: side-banded urea at 70 kg/ha of actual N and seed-placed 14-20-10-10S at 100 kg/ha product. Target seeding rate was 300 plants per meter square. Plots of 4 X 10 meters were arranged in a randomized complete block design with four replicates. STELLAR (2.5 g/L florasulam + 100 g/L fluroxypyr and 600 g/L MCPA ester) and AXIAL (100 g/L pinoxaden) herbicides were applied as a tank mix with Adigor adjuvant in crop at the 3-4 leaf stage (label rates) to control broadleaf and grassy weeds on June 7th.

Fungicides were applied at flag leaf fully emerged on July 3rd using a 2 meter boom mounted on the front of a 4 wheel ATV. PROLINE was applied in 100 L water /ha and TILT 250E was applied in 200 L water/ha as per label directions. Plots were monitored weekly for disease. Ten plants per plot were then assessed on July 26th at the late milk/early dough growth stage using a 0-11 point scale (Horsfall-Barratt), converted to a percentage leaf area diseased for flag and penultimate leaves. Plants were also assigned a rating between 0-11 (McFadden scale) based on assessment of disease symptoms on foliage of the whole plant, total disease was assessed as opposed to each individual pathogen severity.
Yield measurements were made on harvested samples taken from the centre of each plot on August 24th with a Wintersteiger plot combine. Quality measurements were taken from harvested samples and data were analyzed using analysis of variance procedures and fungicide treatment means deemed significantly different from the check using Dunnett's t test.

RESULTS: See Table 1.

CONCLUSIONS: Plots were seeded into more than adequate moisture with cool soil temperatures in the spring of 2012. Plants emerged 12 days after seeding but during the time period from seeding to emergence another 27 + mm of rain occurred which saturated the soil and created a hard pan that plants struggled to break through. Plants remained with wet feet continuing thru more than 12 precipitation events in June which added another 44+ mm above the long term average rainfall which is 63.5 mm. Plots were yellowing slightly by this time and warmer temperatures in the first week of June helped alleviate those symptoms. Above average rainfall continued for July with warm temperatures but surprisingly did not translate into heavy disease pressure. Harrington the most susceptible cultivar had the highest levels of disease for all foliar ratings. PROLINE was effective in increasing yields and improving kernel characteristics as well as reducing disease on Harrington and did show some effect of disease reduction on the penultimate leaves on AC Metcalfe.

Response to fungicides was limited to the most susceptible cultivar tested, Harrington; those with good host resistance saw no benefit from a fungicide application.

Table 1. Effect of fungicide treatment on three Barley cultivars with varying resistance levels to Net form and spot form Net Blotch for foliar disease severity (flag and penultimate leaves and whole plant), yield, thousand seed weight (TSW), test weight (TW), plump (%) and thins (%) at Melfort , 2012

		Yield Kg/ha	TW (kg/HL)	TSW (g)	Plump %	Thin %	Flag Leaf %	Pen Leaf %	Whole Plant (0-11)
Harrington									
	TILT	3514	54.2	37.8	70.2	5.0	11.6	29.7	7.3
	PROLINE	4190*	56.4*	39.4*	78.6	4.5	5.5*	13.1*	5.8*
	Check	3297	53.9	35.5	70.0	3.2	22.5	43.4	8.7
AC Metcalfe									
	TILT	4021	58.0	38.6	80.9	2.3	4.8	9.0	5.6
	PROLINE	4088	57.9	39.0	80.8	3.1	2.7	4.6*	4.3
	Check	3912	58.1	38.5	79.7	2.3	3.3	9.7	4.9
Newdale									
	TILT	5077	57.6	39.3	79.6	2.8	3.0	5.0	4.4
	PROLINE	4969	57.3	38.6	75.8	3.5	2.6	3.4	3.4
	Check	5089	58.0	39.1	79.6	3.2	5.4	8.5	5.0

*Treatments different from the unsprayed check indicated by asterisks using the Dunnett's test.

2012 PMR REPORT# 15 SECTION O: CEREALS, FORAGE CROPS AND OILSEEDS -Diseases

CROP: Wheat (*Triticum aestivum L.*), cvs. *AC Barrie, Infinity and 5603HR*
PEST: Tan spot (*Pyrenophora tritici-repentis* (Died.) Drechs), Septoria complex (*Septoria spp*.) Fusarium Head Blight (*Fusarium spp*.)

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TITLE: EFFECT OF FUNGICIDE ON LEAF SPOT DISEASES AND YIELD OF AC BARRIE, INFINITY and 5603HR WHEAT AT MELFORT, 2012

MATERIALS: Check, TILT 250E (propiconazole 125 g. ai/ha), HEADLINE EC (pyraclostrobin 148 g. ai/ha) and PROSARO 250 EC (prothioconazole + tebuconazole 200 g. ai/ha).

METHODS: Three Canadian Western Red Spring wheat cultivars: Infinity, 5603HR both rated good for leaf spot disease resistance and AC Barrie, rated poor, according to the Saskatchewan Varieties of Grain Crops 2012, were direct seeded into the previous seasons wheat stubble (with a history of Fusarium Head blight) on May 11th using an Edward's hoe drill with a 20 cm (8 inch) row space. The 5603 HR cultivar has awned heads while the others are awnless. Fertilizer was applied at soil test recommendations: side-banded urea at 70 kg/ha of actual N and seed-placed 14-20-10-10 at 100 kg/ha. Target seeding rate was 300 plants per square meter, all seed was fungicide treated just prior to seeding with RAXIL MD (tebuconazole and metalaxyl) to prevent seed rot and pre-emergent damping off. Plots were 4 X 10 meters arranged in a randomized complete block design with four replicates. STELLAR (2.5 g/L florasulam + 100 g/L fluroxypyr and 600 g/L MCPA ester) and AXIAL (100 g/L pinoxaden) herbicides were applied as a tank mix with Adigor adjuvant in crop at the 3-4 leaf stage (label rates) to control broadleaf and grassy weeds on June 7th.

HEADLINE EC and PROSARO 250 EC were applied in 100 L water /ha and TILT 250E was applied in 200 L water/ha. HEADLINE and TILT fungicides were applied when the flag leaf was fully emerged on July 5th using a 2 meter boom mounted on the front of a 4 wheel ATV. PROSARO was applied with the same equipment July 19th at approximately the 50% flowering stage. This application date was on the latter end of the optimum timing spectrum due to rain delays. Plots were monitored for leaf spot symptoms and assessed on July 31st at the late milk growth stage using a 0-11 point scale (Horsfall-Barratt) converted to a percentage leaf area diseased for flag and penultimate leaves. Plants were also assigned a rating between 0-11 (McFadden scale) based on assessment of disease symptoms on foliage of the whole plant. Fifty heads per plot were removed and collected on August 13th, placed in the freezer overnight and assessed for fusarium head blight (FHB) infection the following day. FHB levels were assessed on a visual scale provided by NDSU of 0 to 10 where 1= 10% spike infection and 10=100% spike infection.

Yield measurements were made on harvested samples taken from a 1.3 x 10 meter strip from the centre of each plot on September 7th with a Wintersteiger plot combine. Quality (thousand kernel weight and test weight) was assessed on harvested samples, data analyzed using analysis of variance procedures, and treatment means different the unsprayed check determined with Dunnett's t test.

RESULTS: See Table 1.

CONCLUSIONS: All plots were seeded early May in ideal soil moisture and air temperatures conditions with rows visible within 10 days. Temperatures later in the month dipped slightly; the last frost on May 25th with no damage detected on any of the plots. Rainfall amounts in excess of 112 mm in June plus another 100 mm in July combined for 77 mm of precipitation above the long term averages for those months. This seemed to have a negative impact on foliar leaf disease as levels on the checks of all cultivars was <10% for the flag leaf evaluations and <28% for the most susceptible cultivar on the penultimate leaves. Whole plant ratings showed minimal levels of leaf disease across all the cultivars. Even with low disease pressure HEADLINE and TILT applications did reduce the amount of leaf infection on AC Barrie and Infinity wheat on the penultimate and whole plant. Disease severity on flag leaves was reduced by HEADLINE and PROSARO on the same two cultivars. None of the fungicides tested showed improved disease control potential from that of the check for 5603HR.
Infinity, rated "Very Poor" for FHB having 34 and 25 percent greater spike infection levels than AC Barrie and 5603HR which are rated "Fair" and showed a significant decrease in infection from the check with the use of PROSARO. The "Fair" rated cultivars were not improved, in this trial, with the use of fungicides with respect to this disease.

Thousand seed weights and test weights of all cultivars were improved with the application of PROSARO, while TILT had showed a benefit over the check only for thousand seed weight on AC Barrie. PROSARO, while improving the yields of 5603HR and Infinity, did not show any benefit when applied to AC Barrier.

Under conditions at Melfort in 2012 where foliar leaf disease pressure was light, fungicides reduced leaf spot severity slightly, but had no effect on yields. TILT increased TSW of AC Barrie. Fields such as this one, with a history of FHB infection, showed gains in quality data from the application of PROSARO for all cultivars tested and yields of two cultivars were significantly higher than the unsprayed check.

Table 1. Effect of fungicide treatment on AC Barrie, Infinity and 5603HR wheat for foliar disease symptoms (flag and flag-1leaves and whole plant), % spike infection (Fusarium Head Blight), yield, thousand seed weight (TSW) and test weight (TW) at Melfort, 2012.

		Yield Kg/ha	TSW (g)	TW (kg/hL)	Flag leaf %	Flag -1 Leaf %	Whole Plant (0-11)	FHB % spike
AC Barrie								
	TILT	4033	36.2*	77.7	5.4	6.1*	2.6*	38.2
	HEADLINE	4096	34.9	77.7	4.1*	2.9*	2.1*	32.1
	PROSARO	4420	36.7*	78.7*	4.0*	15.6	3.3	30.6
	Check	3450	33.3	77.3	8.8	28.2	4.8	30.9
Infinity								
	TILT	3208	29.4	73.5	4.5	7.2*	2.9*	54.8
	HEADLINE	3319	29.0	73.3	2.6*	3.4*	2.5*	54.9
	PROSARO	4122*	31.0*	76.3*	3.1*	13.0	3.5	41.5*
	Check	3044	27.9	72.7	7.5	25.8	4.2	64.7
5603 HR								
	TILT	4061	31.7	76.5	3.7	4.2	2.7	41.3
	HEADLINE	4181	31.5	77.3	3.5	4.2	2.5	38.8
	PROSARO	4924*	32.4*	78.5*	3.0	5.6	2.8	26.1
	Check	3879	30.2	77.0	4.3	17.8	3.6	39.4

*Treatments different from unsprayed check using Dunnett's t test.