2013 Pest Management Research Report (PMRR) 2013 Growing Season

2013 Rapport de recherches sur la lutte dirigée (RRLD) pour la saison 2013

Canada

English

2013 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 fourteenth 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 9 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.

Suggestions for improving this publication are always welcome.

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Procedures for the 2014 Annual PMR Report will be sent in fall, 2014. 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 2013 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). 2013. Title. 2013 Pest Management Research Report - 2013 Growing Season. Agriculture and AgriFood Canada. February 2014. Report No. x. Vol. 52: pp-pp.

Français

Rapport de recherches sur la lutte dirigée - 2013

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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 9 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.

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 2014 PMR seront introduites à l'automne 2014. 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. 2013. Titre. 2013 Rapport de recherche sur la lutte dirigée. Agriculture et Agroalimentaire Canada. fevrier, 2014. Rapport n^{o} x. vol. 52: pp-pp.

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2013 PMR Report # 01 **SECTION B: VEGETABLES and SPECIAL CROPS – Insect Pests**

CROP: Sweet corn (*Zea mays* L. subsp. *mays*), cv. Temptation
PEST: European corn borer (*Ostrinia nubilalis* Hübner), western bean cutworm (*Striacosta albicosta* Smith), corn earworm (*Helicoverpa zea* Boddie)

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TITLE: FIELD EVALUATION OF PRODUCTS FOR MANAGEMENT OF EUROPEAN CORN BORER, CORN EARWORM, AND WESTERN BEAN CUTWORM IN SWEET CORN, 2013

MATERIALS: CORAGEN (chlorantraniliprole 200 g/L), INTREPID (methoxyfenozide 240 g L^{-1}), MATADOR 120 EC (cyhalothrin-lambda 120 g L^{-1}), DELEGATE WG (spinetoram 25%), ENTRUST 80 (spinosad 80%), VOLIAM XPRESS (cyhalothrin-lambda 50 g/L + chlorantraniliprole 100 g/L)

METHODS: A trial was completed at Ridgetown Campus, University of Guelph. Sweet corn hybrid 'Temptation' was seeded with a Kearny planter on June 12 at a rate of 5 seeds/m. The trial was setup as a randomized complete block design with 4 replicates per treatment. Each treatment plot consisted of 6 rows spaced 75 cm apart and 7 m in length. The four outside rows (rows 1, 2, 5, 6) were guard rows while the two inner rows (rows 3 and 4) were used for the damage assessment. A 1.5 m pathway was maintained between each plot within the same replication and a 2 m pathway was maintained between each replicated block. Applications were made on July 25 (tassel emergence), Aug 1 (full tassel), and Aug 9 (silking) using a hand-held 1.5 m boom CO_2 sprayer (35 psi) with AT110-03VS nozzles, and water volume of 300 L/Ha. All corn cobs from rows 3 and 4 in each plot were harvested and assessed for feeding damage on husks and cobs on Aug 23 (replications 1 and 2) and 26 (replications 3 and 4). The number and species of larvae found feeding on corn ears were also recorded, including European corn borer (ECB), corn earworm (CEW), and western bean cutworm (WBC). Statistical analysis was conducted using ARM 7 (Gylling Data Management, Brookings, SD). Data were tested for normality using Bartlett's homogeneity of variance test. Analysis of variance was completed and means were separated using Tukey's HSD, $P \leq 0.05$.

RESULTS: As outlined in Table 1.

CONCLUSIONS: CORAGEN, INTREPID, MATADOR 120 EC, DELEGATE, ENTRUST, and VOLIAM XPRESS reduced the incidence of feeding damage on sweet corn. ECB was the dominant pest in the trial and there was very little insect pressure from WBC or CEW.

Table 1. Incidence of insect larvae and feeding damage detected in sweet corn cobs treated with insecticides for management of western bean cutworm (WBC), European corn borer (ECB), and corn earworm (CEW), Ridgetown, ON, 2013.

Treatment (rate)	Lepidopteran Larvae (# per plot)			Feeding Damage (%) [1]	
	WBC	ECB [2]	CEW	Husks [2]	Cobs [2]
Nontreated control	0.0 a [3]	4.3 a	0.5 a	7.7 a	6.6 a
MATADOR @ 83 mL/Ha	0.0 a	0.1 b	0.0 a	0.0 b	0.5 b
INTREPID @ 600 mL/Ha	0.0 a	0.6 b	0.0 a	0.7 b	0.6 b
CORAGEN @ 375 mL/Ha	0.0 a	0.0 b	0.0 a	0.0 b	0.6 b
ENTRUST @ 50 g/Ha	0.0 a	0.4 b	0.3 a	0.3 b	0.3 b
DELEGATE @ 120 g/Ha	0.0 a	0.2 b	0.0 a	0.3 b	0.3 b
DELEGATE @ 210 g/Ha	0.0 a	0.2 b	0.0 a	0.9 b	0.0 b
VOLIAM XPRESS @ 500 mL/Ha	0.3 a	0.0 b	0.0 a	0.4 b	0.3 b

[1] Husks refers to the percentage of sweet corn with feeding damage on the husk, and cobs refers to percentage of sweet corn with feeding damage on corn kernels.
[2] Data were transformed using a log transformation; the back transformed means are shown here.
[3] Numbers in a column followed by the same letter are not significantly different at $P \leq 0.05$, Tukey's adjustment.

2013 PMR REPORT #02 **SECTION C: POTATOES - Insect Pests**

CROP: Potato (*Solanum tuberosum*), cv. Russet Burbank
PEST: Wireworms

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TITLE: EFFICACY OF IN-FURROW AND SEED PIECE INSECTICIDE TREATMENTS IN SUPRESSING WIREWORM DAMAGE IN POTATOES, 2013

MATERIALS: THIMET 15G (Phorate), CAPTURE 240 EC (Bifenthrin), ADMIRE 240F (Imidacloprid), FIPRONIL 4SC (Fipronil), EXPERIMENTAL 5672774

METHODS: The research trial was conducted in plots located in a field in Canoe Cove, P. E. I. Plots were set up in a randomized complete-block design, with seven treatments and four replicates per treatment. Rows were spaced 0.9 m apart, with in-row spacing of plants at 0.38 m. There were ADMIRE-treated buffer rows of potatoes between plots within a replication, and 3.0 m bare soil pathways between replicates. Fertilizer 10-20-20 (N:P:K) was banded at a rate of 1305 kg/ha was used. Plots were planted on 7 June 2013. Insecticidal treatments consisted of 1) UNTREATED CHECK, 2) THIMET applied in-furrow at 215 g/100 m row; 3) CAPTURE applied as an in-furrow T-band at 311gai/ha+ ADMIRE at 258 g ai/ha 4) CAPTURE (applied as an in-furrow T-band at 264g ai/ha + ADMIRE at 258 g ai/ha 5) Dividend-treated wheat seed treated with FIPRONIL at 3.0 g ai/100kg seed applied in furrow alongside the tuber at the rate of 3 seeds per 1.75 cm of row equal to 1.95 g ai/ha 6) Dividend-treated wheat seed treated with FIPRONIL at 3.0 g ai/100 kg seed. Application rate will be 1.5 seeds per 1.75 cm of row for a rate of 1.00 g ai/ha 7) EXPERIMENTAL 5672774 at the rate of 10 g ai/100 kg of seed. This treatment was planted 7 days later due to shipping delays. All in-furrow treatments were applied into the open furrow and the potatoes were planted by hand. For treatment 5 and 6, treated wheat seeds were sprinkled in the open furrow beside the seed piece at the desired rate. Emergence counts in all plots were done on 6 July, and plants were examined for phytotoxicity. On 26 June, a standard pre-emergence application of LOROX 400FL (Linuron) at 2.5 L /ha was applied to plots for weed control. Throughout the summer, plots received recommended applications of Bravo 500 (chlorothalonil) at 1.25 kg ai/ha for late blight. On 8 and 11 September, the top desiccant REGLONE 240 (Diquat) was applied at the rate of 370 g ai/ha. Samples were collected on two dates and consisted of all tubers from row 1 (Sample 1) 30 September and row 2 (Sample 2) 9 October from each plot. Tubers were washed and any with a diameter of less than 1.0 cm were discarded. Within every sample, each individual tuber was examined. Wireworm scars (healed damage) and holes (fresh damage) were counted, processing marketability was assessed using processing industry standards, holes and scars were peeled and if a tuber lost greater than 5% of its total weight it was considered unmarketable. Counts of blemishes (holes and scars) were transformed to Ln(x+1) and an

Analysis of Variance (ANOVA) was performed on the data, and Least Significant Differences (LSD, P=0.05) were calculated. Untransformed means are presented.

RESULTS: As outlined in Tables 1 – 3.

CONCLUSIONS: Under the conditions of this study, THIMET, CAPTURE HIGH+ADMIRE, and CAPTURE LOW+ADMIRE provided the best wireworm damage suppression compared to the other treatments. A decrease in damage was seen for these treatments in both early and late harvest samples suggesting that the efficacy of the insecticide continues late into the harvest season which is important for late maturing varieties. Metric tonnes per hectare lost due to wireworm damage were significantly lower in the THIMET and CAPTURE HIGH+ADMIRE and CAPTURE LOW+ADMIRE treatments which resulted in higher marketable yield, once again suggesting that these treatments are superior in supressing wireworm damage to tubers.

Table 1. Effectiveness of seed-piece or in-furrow insecticide treatments in supressing wireworm damage to Russet Burbank potato tubers on two sample dates, Canoe Cove, PEI, (2013).

Insecticide Applied	Rate (g ai/ha)	Method[1]	Sample 1(30 September)		Sample 2 (9 October)	
			Mean # of scars	Mean #of holes	Mean # of scars	Mean # of holes
CHECK - none	-	-	3.9 c	7.2 d	4.5 b	8.2 d
THIMET 15 G	215 g[2]	IFG	1.9 a	3.6 ab	2.0 a	3.9 a
CAPTURE HIGH +ADMIRE	311 g + 258g	IFS	1.7 a	3.2 a	2.7 ab	4.3 ab
CAPTURE LOW +ADMIRE	264g + 258g	IFS	2.2 ab	4.1 bc	2.6 ab	3.7 a
FIPRONIL treated wheat full rate	1.95g	IF	2.6 abc	5.7 cd	3.2 ab	6.2 cd
FIPRONIL treated wheat half rate	1g	IF	2.7 abc	6.1 cd	3.1 ab	5.8 bc
EXPERIMENTAL 55672774	10 g[3]	SPT	2.3 abc	4.3 bc	2.5ab	4.2 ab

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

Table 2. Effectiveness of seed-piece or in-furrow insecticide treatments in supressing wireworm damage to Russet Burbank potato tubers, Canoe Cove, PEI, 2013. (Data from the two sample dates (30 September and 10 October) combined)

Insecticide Applied	Rate (g ai/ha)	Method[1]	Mean # scars/tuber	Mean # holes/tuber	Total damage (scars+holes) /tuber
CHECK - none	-	-	4.2b	7.8 c	11.9 d
THIMET 15 G	215 g[2]	IFG	2.0 a	3.8 a	5.7 a
CAPTURE HIGH +ADMIRE	311 g + 258g	IFS	2.2 a	3.7 a	5.8 a
CAPTURE LOW +ADMIRE	264g + 258g	IFS	2.4 a	3.9 a	6.3 ab
FIPRONIL treated wheat full rate	1.95g	IF	2.9 a	5.9 c	8.8 c
FIPRONIL treated wheat half rate	1g	IF	2.7 a	5.9 b	8.7 bc
EXPERIMENTAL 55672774	10 g[3]	SPT	2.4 a	4.2 ab	6.6 ab

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

Table 3. Effectiveness of seed-piece or in-furrow insecticide treatments in supressing wireworm damage to Russet Burbank potato tubers, Canoe Cove, PEI, 2007. (Data from the two sample dates (30 September and 10 October) combined)

			Yield				
Insecticide Applied	Rate (g ai/ha)	Method[1]	Total Market	No damage Market	Damaged but marketable	Damaged non-marketable	Residual marketable
CHECK - none	-	-	30.8 ab	0.0a	11.7a	19.1c	11.7 a
THIMET 15 G	215 g[2]	IFG	34.7 b	2.3 b	27.7 c	4.6 a	29.9 d
CAPTURE HIGH +ADMIRE	311 g + 258g	IFS	31.7 ab	4.2 c	20.7 b	6.7 ab	24.8 cd
CAPTURE LOW +ADMIRE	264g + 258g	IFS	34.3 b	2.9 bc	23.9 bc	7.5 ab	26.7 d
FIPRONIL treated wheat full rate	1.95g	IF	32.6 b	0.3 a	20.8 b	11.4 b	21.0 bc
FIPRONIL treated wheat half rate	1g	IF	31.2 ab	0.4 a	19.2 b	11.2 b	19.7 b
EXPERIMENTAL 55672774	10 g[3]	SPT	28.2 ab	0.8 a	19.6 b	7.7 ab	20.4 bc

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

2013 PMR REPORT # 03 **SECTION J: NEMATODES**

CROP: Garlic (*Allium sativum* (L.)) cv. Music

PEST: Stem and bulb nematode (*Ditylenchus dipsaci* (Kuhn) Filipjev)

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TITLE: EFFECT OF APPLYING DIFFERENT RATES OF AGRI-MEK AS A DRENCH AT PLANTING OVER STEM AND BULB NEMATODE-INFESTED GARLIC CLOVES CV. MUSIC COMPARED TO SOAKING INFESTED GLOVES IN AN AGRI-MEK SOLUTION PRIOR TO PLANTING ON YIELD, NEMATODE DAMAGE AND NEMATODE POPULATIONS IN THE BULBS AT HARVEST IN 2013

MATERIALS: AGRI-MEK (19 g/L abamectin a.i.)

METHODS: Garlic cloves cv. Music infested with *Ditylenchus dipsaci* (432 nematodes/g dry cloves) were either soaked in a solution of AGRI-MEK (19 g /L abamectin) at 3.79 ml /litre of water (0.072 g abamectin/L water) for 4 hours (AGRI-MEK SOAK), soaked in water (approximately 17^{o}C) for 4 hours (WATER SOAK) or left untreated. Treated and untreated cloves were planted 28 per plot, 5 cm deep and 15.2 cm apart in open furrows in 4 rows spaced 76.2 cm apart on 23 April 2013. A 20 cm wide band of AGRI-MEK at either 0.6 L/ha (11.4 g abamectin/ha), 1.2 L/ha (22.8 g abamectin/ha), 1.8 L/ha (34.2 g abamectin/ha), 2.4 L/ha (45.6 g abamectin/ha) or 3.6 L/ha (68.4 g abamectin/ha) in 1384 L of H_2O/ha was drenched over separate plots planted with untreated nematode infested cloves in open furrows prior to covering the furrows. The drenches were applied using a hand held wand sprayer (R&D Sprayers, Opelousas, LA) with a single adjustable cone nozzles propelled with CO_2 at 280 kPa. Some plots with untreated nematode infested-garlic cloves in open furrows were drenched prior to covering with 1384 L of H2O/ha (WATER DRENCH) for comparison. The furrows were closed immediately after drenching. Treatments were replicated 4 times and arranged in a randomized complete block design. Garlic scapes were removed on 25 June 2013 to improve bulb growth. Garlic bulbs were harvested, counted, weighed and rated for stem and bulb nematode damage (0 = no damage; 1= slight damage; 2= moderate damage; 3= severe damage, 4= dead ie shrivelled, desiccated) on 18 July 2013. Stem and bulb nematodes were extracted from 10 randomly selected bulbs harvested from each plot using Baermann funnels in a mist chamber for 24 hours. The nematodes extracted from the garlic bulbs were identified to genus and enumerated. The garlic bulbs were then dried at 80^{o}C for 72 hours to obtain the dry weight. Nematode data was transformed using the Log (nematode/g dried bulb +1) to improve normality and additivity prior to statistical analysis. All data was analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.9. Tukey HSD test was used to detect differences among the means at *P*=0.05.

RESULTS: Soaking stem and bulb nematode-infested garlic cloves cv. Music in 3.79 ml AGRI-MEK/L of water for four hours prior to planting resulted in significantly higher yields, less damage and fewer nematodes in the harvested garlic bulbs compared to bulbs harvested from plots that were drenched with an AGRI-MEK solution over the cloves in open furrows prior to covering (Table 1). As the AGRI-MEK concentration applied as a drench over infested cloves increased from 0.6 L/ha to 3.6 L/ha, a trend of less damage and lower nematode numbers per bulb at harvest was detected through regression analysis but the trend was not statistically significant. The rate of an AGRI-MEK drench applied at planting that significantly reduces stem and bulb nematodes in the harvested bulbs was not established in this trial. None of the treatments significantly affected the number of garlic bulbs harvested/plot.

CONCLUSION: Soaking nematode-infested Music garlic cloves in 3.79 ml AGRI-MEK/L of water for four hours prior to planting significantly increased yields, reduced nematode damage and the number of nematodes in garlic bulbs at harvest compared to bulbs harvested from plots that were drenched with an AGRI-MEK solution over nematode-infested cloves in open furrows prior to closing. Drenching *D. dipsaci* infested garlic cloves in open furrows at planting with the rates of AGRI-MEK used in this trial did not significantly affect yield, the number of bulbs harvested, reduce the severity of nematode damage or the number of stem and bulb nematodes per bulbs at harvest compared to water drenched over the infested garlic cloves at planting.

Table1. The effect of drenching AGRI-MEK at 0.6 L/ha, 1.2 L/ha, 1.8 L/ha, 2.4 L/ha and 3.6 L/ha over garlic cloves infested with *D. dipsaci* in open furrows at planting compared to soaking infested garlic cloves in 3.79 ml of AGRI-MEK/L H_2O for 4 hours prior to planting on the number of garlic bulbs, yield weight, nematode damage and population of *D. dipsaci* in garlic bulbs harvested in 2013.

Treatment	Rate	Mean Number of garlic bulbs harvested/plot	Yield weight (kg/m^2)	Nematode Damage (0-4)[1]	*D. dipsaci* per g dried bulb at harvest[2]
WATER SOAK	NA	27 a[3]	0.390 ab	1.9 a	171 a
AGRI-MEK SOAK	3.79 ml/L H_2O	28 a	0.449 a	0.6 b	22 b
WATER DRENCH	NA	27 a	0.328 b	1.9 a	185 a
AGRI-MEK DRENCH	0.6 L/ha	27 a	0.364 b	1.5 a	101 a
AGRI-MEK DRENCH	1.2 L/ha	26 a	0.347 b	1.6 a	177 a
AGRI-MEK DRENCH	1.8 L/ha	26 a	0.339 b	1.6 a	108 a
AGRI-MEK DRENCH	2.4 L/ha	27 a	0.373 b	1.5 a	142 a
AGRI-MEK DRENCH	3.6 L/ha	26 a	0.369 b	1.4 a	112 a

1. Nematode damage 0 = no damage; 1= slight damage; 2= moderate damage; 3= severe damage, 4= dead
2. Data was transformed using the Log (No. of nematodes/g dried bulb +1) to improve normality and additivity prior to statistical analysis however, actual means are presented
3. Figures within columns followed by different letters are significantly different using Tukey HSD test (P<0.05)

2013 PMR REPORT # 04 **SECTION J: NEMATODES**

CROP: Garlic (*Allium sativum* (L.)) cv. Music

PEST: Stem and bulb nematode (*Ditylenchus dipsaci* (Kuhn) Filipjev)

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TITLE: **EFFECTS OF DRENCHING AGRI-MEK ON STEM AND BULB NEMATODE-INFESTED CLOVES AT PLANTING FOLLOWED BY ONE OR TWO FOLIAR APPLICATIONS OF AGRI-MEK ON THE YIELD, NEMATODE DAMAGE AND NEMATODE POPULATIONS IN MUSIC GARLIC BULBS HARVESTED IN 2013**

MATERIALS: AGRI-MEK (19 g/L abamectin a.i.)

METHODS: Garlic cloves cv. Music infested with *Ditylenchus dipsaci* (432 nematodes/g dry cloves) were planted 28 per plot, 5 cm deep and 15.2 cm apart in open furrows in 4 rows spaced 76.2 cm apart on 23 April 2013. A 20 cm wide band of 1.2 L AGRI-MEK/ha (22.8 g abamectin/ha) in 1384 L/ha water was drenched over the cloves in the open furrows of half the plots prior to closing using a hand held wand sprayer (R&D Sprayers, Opelousas, LA) with a single adjustable cone nozzles propelled with CO_2 at 280 kPa (AGRI-MEK DRENCH). Cloves in the other half of the plots were drench with 1384 L of H2O/ha in the open furrows prior to covering (WATER DRENCH). The furrows were closed immediately after drenching. One or two applications of AGRI-MEK at 1.2 L/ha was applied to some of the WATER DRENCH and AGRI-MEK DRENCH plots as foliar sprays in 692 L of water/ha on 27 May 2013 (4-5 leaves) and/or 6 June 2013 (6-7 leaves) using a hand held wand sprayer (R&D Sprayers, Opelousas, LA) with 3 adjustable cone nozzles spaced 30 cm apart, propelled with CO2 at 280 kPa. Treatments were replicated 4 times and arranged in a randomized complete block design. Garlic scapes were removed on 25 June 2013 to improve bulb growth. Garlic bulbs were harvested from the plots, counted, weighed and rated for stem and bulb nematode damage (0 = no damage; 1= slight damage; 2= moderate damage; 3= severe damage, 4= dead ie shrivelled, desiccated) on 18 July 2013. Stem and bulb nematodes were extracted from 10 randomly selected bulbs harvested from each plot using Baermann funnels in a mist chamber for 24 hours. The nematodes extracted from the garlic bulbs were identified to genus and enumerated. The garlic bulbs were then dried at 80°C for 72 hours to obtain the dry weight. Nematode data was transformed using the Log (nematode/g dried bulb +1) to improve normality and additivity prior to statistical analysis. All data was analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.9. Tukey HSD test was used to detect differences among the means at P=0.05.

RESULTS: No significant interactions were detected among treatments and main effects are reported in Tables 1 and 2. Drenching AGRI-MEK at 1.2L/ha over stem and bulb-infested garlic cloves in open furrows prior to covering, reduced the nematode population per bulb at harvest compared to drenching with water regardless if foliar AGRI-MEK applications were made later in the growing season (Table 1). However the population of nematodes in the harvested bulbs was still unacceptably high in from plots that received the AGRI-MEK drench at planting. No significant reduction in damage to bulbs or increase in garlic yield at harvest was noticed regardless if an AGRI-MEK DRENCH was applied over nematode-infested cloves at planting compared to the WATER DRENCH regardless if AGRI-MEK was applied as a foliar spray later in the growing season. The frequency of applying AGRI-MEK as a foliar spray had no significant effect on the number of bulbs harvested/plot, yield, nematode damage or population of nematodes in bulbs at harvest whether or not the infested garlic seed was drenched with AGRI-MEK or water at planting (Table 2).

CONCLUSION: Drenching 1.2 L/ha of AGRI-MEK over stem and bulb infested-garlic cloves in open furrows prior to covering reduced the nematodes population in the garlic bulbs at harvest compared to drenching with water, however the population of nematodes was still unacceptably high in the bulbs at harvest.

Table1. The main effect of drenching AGRI-MEK at 1.2 L/ha compared to drenching water over garlic cloves in open furrows prior to covering on the number of garlic bulbs harvested/plot, yield, nematode damage and the population of *D. dipsaci* in garlic bulbs harvested in 2013.

Treatment	Rate	Mean Number of garlic bulbs harvested/plot	Yield weight (kg/m^2)	Nematode Damage (0-4)[1]	*D. dipsaci* per g dried bulb at harvest[2]
WATER DRENCH	1384 L/ha	27 a	0.392 a	1.6 a	170 a
AGRI-MEK DRENCH	1.2 L/ha	27 a	0.405 a	1.6 a	89 b

4. Nematode damage 0 = no damage; 1= slight damage; 2= moderate damage; 3= severe damage, 4= dead
5. Data was transformed using the Log (No. of nematodes/g dried bulb +1) to improve normality and additivity prior to statistical analysis however, actual means are presented
6. Figures within columns followed by different letters are significantly different using Tukey HSD test (P<0.05)

Table 2. The main effect of the number of foliar applications of AGRI-MEK at 1.2 L/ha to garlic plants grown from nematode-infested cloves that were either drenched with water or AGRI-MEK at 1.2 L/ha at planting on the number of garlic bulbs harvested/plot, yield, nematode damage and population of *D. dipsaci* in garlic bulbs harvested in 2013.

Number of Foliar applications of AGRI-MEK	Rate	Mean Number of garlic bulbs harvested/plot	Yield weight (kg/m^2)	Nematode Damage (0-4)[1]	*D. dipsaci* per g dried bulb at harvest[2]
0	NA	27 a	0.412 a	1.6 a	164 a
1	1.2 L/ha	26 a	0.383 a	1.5 a	101 a
2	2 X 1.2 L/ha	27 a	0.401 a	1.5 a	123 a

7. Nematode damage 0 = no damage; 1= slight damage; 2= moderate damage; 3= severe damage, 4= dead
8. Data was transformed using the Log (No. of nematodes/g dried bulb +1) to improve normality and additivity prior to statistical analysis however, actual means are presented
9. Figures within columns followed by different letters are significantly different using Tukey HSD test ($P<0.05$)

2013 PMR REPORT # 05 SECTION L: VEGETABLES and SPECIAL CROPS - Diseases

CROP: Broccoli (*Brassica oleracea*) cv. Imperial

PEST: Clubroot (*Plasmodiophora brassicae* Woronin)

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TITLE: EFFECT OF MUSTGRO APPLIED IN THE FALL AND SPRING TO SOIL NATURALLY INFESTED WITH *PLASMODIOPHORA BRASSICAE* ON THE INCIDENCE AND SEVERITY OF CLUBROOT IN BROCCOLI

MATERIALS: MUSTGRO (mustard meal) MPT Mustard Products & Technologies Inc. Saskatoon, Saskatchewan

METHODS: Small plots were established in a commercial field located near Troy, Ontario during the fall of 2012 that was naturally infested with the clubroot pathogen *P*. *brassicae*. MUSTGRO (mustard meal) was surface applied with a calibrated fertilizer spreader to some plots at a low rate (980 kg/ha) and high rate (2240 kg/ha) in the fall on 18 October 2012 and to separate plots the following spring on 9 May 2013. An UNTREATED plot was left for comparison. The treatments were replicated 4 times and arranged in a Randomized Complete Block Design. The MUSTGRO was incorporated into the soil (soil type: clay loam) to a depth of 15 cm in each plot with a roto-tiller immediately after application and the treated soil sealed with a roller. Heavy rains followed the fall application but water was applied to the plots with overhead irrigation to a depth of 4 cm following the spring applications. Four rows spaced 81. 3 cm apart of broccoli (cv. Imperial) seedlings were transplanted 21.6 cm apart within the row on 5 June 2013 in each plot. Ten plants with roots per plot were carefully removed from each plot on 13 June, 20 June, 11 July and 31 July 2013, the roots thoroughly washed and assessed for clubroot incidence and severity using a standard 0–3 scale, (0 = no visible clubs, 1 = a few small clubs (small clubs on less than one-third of roots), 2 = moderate clubbing (small to medium sized clubs on one- to two-thirds of roots) and 3 = severe clubbing (medium to large sized clubs on more than two-thirds of roots)). The incidence and severity values were used to calculate area under the disease incidence progress curve (AUDIC) and the area under the disease severity progress curve (AUDSC). Heads were cut from 10 broccoli plants/plot and weighed on 8 August 2013 to assess yield. Data was analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.9. Tukey HSD test was used to detect differences among the means at *P*=0.05.

RESULTS: See Tables 1 and 2.

Table 1. The effect of MUSTGRO applied to soil at 980 kg/ha and 2240 kg/ha in the fall and spring on the incidence of clubroot in broccoli (cv. Imperial) in a clay loam soil at Troy, ON.

Treatment	Application Time	Rate (kg/ha)	% Incidence				
			5 June	20 June	11 July	31 July	AUDIC[1]
UNTREATED	NA	NA	0	10	75	77.5	2492.5
MUSTGRO	Fall	980	0	7.5	65	92.5	2392.5
MUSTGRO	Fall	2240	0	2.5	72.5	90	2431.3
MUSTGRO	Spring	980	0	7.5	80	100	2775
MUSTGRO	Spring	2240	0	10	55	75	2057

[1]Area Under the Disease Incidence Progress Curve

Table 2. The effect of MUSTGRO applied to soil at 980 kg/ha and 2240 kg/ha in the fall and spring on the severity of clubroot in broccoli (cv. Imperial) and yield in a clay loam soil at Troy, ON.

Treatment	Application Time	Rate (kg/ha)	Severity					Yield Weight of 10 Heads (g)
			5 June	20 June	11 July	31 July	AUDS[1]	
UNTREATED	NA	NA	0	0.1	0.98	1.88	40.6	270.6
MUSTGRO	Fall	980	0	0.08	0.7	1.88	34.5	234.2
MUSTGRO	Fall	2240	0	0.03	1.05	2.13	43.3	277.4
MUSTGRO	Spring	980	0	0.08	1.08	2.63	49.7	202.4
MUSTGRO	Spring	2240	0	0.1	0.75	1.7	34.2	242.6

[1]Area Under the Disease Severity Progress Curve

CONCLUSIONS: MUSTGRO applied to the soil surface at either 980 kg/ha or 2240 kg/ha in the fall or spring and incorporated to a depth of 15 cm immediately after application and prior to planting broccoli transplants (cv. Imperial) did not significantly affect the incidence (Table 1) or the severity of club root or yield (Table 2) in this trial.

2013 PMR REPORT #06 SECTION L: VEGETABLE and SPECIAL CROPS – Diseases

CROP: Carrot *(Daucus carota* sub sp. *sativus* (Hoffm.) Arcang.), cv. Cellobunch
PEST: *Fusarium* spp.

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TITLE: EVALUATION OF FUNGICIDES AND BIO-CONTROL PRODUCTS FOR CONTROL OF FUSARIUM ROOT ROT ON CARROTS, 2013

MATERIALS: MERTECT T (thiabendazole 42.3%), EMESTO SILVER (penfluefen 9.35%; prothioconazole 1.68%), HEADS UP (extract of *Chenopodium quinoa* saponins 49.65%), *TRICHODERMA ATROVIRIDE* B (biocontrol product), FOLICUR (tebuconazole 43%),

METHODS: The trial was conducted in a commercial carrot field in the Holland/Bradford Marsh, Ontario, with a history of fusarium root rot of carrots. Carrots (cv. Cellobunch) were direct seeded at 69 seeds/m on raised beds on 19 June, using a Stan Hay Precision seeder. A randomized complete block arrangement with four replicates per treatment was used. Each experimental unit consisted of three hills, 6 m in length, 66 cm apart. Treatments were: FOLICUR at 350 mL/ha, EMESTO STAR at 1 L/ha, *TRICHODERMA ATROVIRIDE* B at 400 g/ha, HEADS UP at 250 g/ha and MERTECT at 5.2 L/ha. An untreated check was also included. Treatments were applied at seeding in 250 L water/ha in-furrow drench, over the carrot seeds. The second foliar application of HEADS UP was applied when the carrots were at 3-4 leaf stage on 2 August using a CO_2 backpack sprayer equipped with four TeeJet 8002 VS fan nozzles spaced 40 cm apart in a boom and calibrated to deliver 400 L/ha at 240 kPa. On 5 September and 15 October, a random sample of 100 carrots was removed from each replicate and placed in cold storage at 1°C until the carrots were assessed. On 2 October and 17 October, carrots from cold storage were washed in a small drum washer and visually assessed for fusarium rot lesions and sorted into classes based on number of lesions per carrot. Compared to the previous 10 year averages, air temperatures in 2013 were average for June (18.5°C), July (21.3°C), August (19.6°C) and September (15.3°C), and above average for October (10.5°C). The 10 year average temperatures were: June 18.4°C, July 20.7°C, August 19.6°C, September 15.5°C and October 9.1°C. Monthly rainfall was above the 10 year average for June (94 mm), July (104 mm), August (87 mm), September (83 mm) and October (92 mm). The 10 year rainfall averages were: June 71 mm, July 82 mm, August 73 mm, September 77 mm and October 60 mm. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.10. Means separation was obtained using Fisher's Protected LSD test with $P = 0.05$ level of significance.

RESULTS: as presented in Tables 1 and 2

CONCLUSIONS: There were no significant differences among the treatments during both the first and second assessment periods. The root rot incidence (22-34%) was lower in the first assessment, which was conducted 12 weeks after seeding compared to the second assessment (81-88% incidence) conducted on carrots collected 17 weeks after seeding. All the products tested were non-phytotoxic to the crop.

Table 1. Incidence and severity of carrot root rot caused by *Fusarium* following treatment with fungicides in muck soil in the Holland Marsh, Ontario, 2013. (First assessment)[1]

Treatment	%Healthy carrots	% Carrots with lesions			% total carrots with lesions
		1 lesion	2 lesions	3 lesions	
EMESTO SILVER	78.0 ns[2]	20.0 ns	2.0 ns	0.0 ns	22.0 ns
MERTECT	77.0	20.0	3.0	0.0	23.0
T. ATROVIRIDE B	75.0	22.0	3.0	0.0	25.0
FOLICUR	73.0	24.0	3.0	0.0	27.0
HEADS UP	70.0	26.0	3.0	1.0	30.3
CHECK	66.0	26.0	7.0	1.0	34.0

[1]carrot roots collected on 5 September for the first assessment
[2]not significant at $P = 0.05$, Fisher's Protected LSD test

Table 2. Incidence and severity of carrot root rot caused by *Fusarium* following treatment with fungicides in muck soil in the Holland Marsh, Ontario, 2013. (Second assessment)[1]

Treatment	%Healthy carrots	% Carrots with lesions				% total carrots with lesions
		1 lesion	2 lesions	3 lesions	4 lesions	
FOLICUR	16.3 ns[2]	17.8 ns	23.5 ns	13.5 ns	29.0 ns	83.7 ns
MERTECT	14.8	26.5	19.3	16.5	22.8	85.2
EMESTO SILVER	13.5	20.3	19.8	13.3	33.3	86.5
T. ATROVIRIDE B	12.3	22.8	23.3	12.8	29.0	87.7
CHECK	11.3	24.0	24.3	12.8	28.0	88.7
HEADS UP	8.3	24.3	23.5	14.3	29.8	81.7

[1]carrot roots collected on 15 October for the second assessment
[2]not significant at $P = 0.05$, Fisher's Protected LSD test

ACKNOWLEDGEMENTS: Investment in this project has been provided by Agriculture and Agri-Food Canada through the Canadian Agricultural Adaptation Program (CAAP). In Ontario, this program is delivered by the Agricultural Adaptation Council. This is a collaborative project with the Bradford Cooperative Storage Ltd.

2013 PMR REPORT #07 SECTION L: VEGETABLE and SPECIAL CROPS – Diseases

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

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TITLE: EVALUATION OF FUNGICIDES FOR CONTROL OF STEMPHYLIUM LEAF BLIGHT IN ONIONS, 2013

MATERIALS: PRISTINE (pyraclostrobin 25.2%, boscalid 12.8%), DITHANE 750 F (mancozeb 75%), SWITCH 62.5WG (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. Patterson) was direct seeded at 34 seeds/m using a Stanhay Precision Seeder on 7 May into organic soil (organic matter ≈ 62%, 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, DITHANE 750 F at 3.25 kg/ha, SWITCH 62.5WG 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 15 and 25 July, and 2, 9 and 19 August using a CO_2 backpack sprayer equipped with four TeeJet 8002 VS fan nozzles spaced 40 cm apart on a boom and calibrated to deliver 400 L/ha at 240 kPa. Experimental plots were assessed on 20 and 27 July, 7 and 17 August, and rated for stemphylium leaf blight severity 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:

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

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 with visible stemphylium leaf blight symptoms. On 19 September, onions in two 2.32 m sections of row from each replicate were pulled to determine yield. The onions were weighed and graded for size on 13 November. Compared to the previous 10 year averages, air temperatures in 2013 were average for June (18.5°C), July (21.3°C), August (19.6°C) and September (15.3°C), and above average for May (14.8°C). The 10 year average temperatures were: May 12.9°C, June 18.4°C, July 20.7°C, August 19.6°C and September

15.5°C. Monthly rainfall was above the 10 year average for May (113 mm), June (94 mm), July (104 mm), August (87 mm) and September (83 mm). The 10 year rainfall averages were: May 72 mm, June 71 mm, July 82 mm, August 73 mm and September 77 mm.
Data were analysed using the General Analysis of Variance function of the Linear Models section of Statistix V.10. 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 2013, 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 was more effective in reducing stemphylium leaf blight with 11.8% foliage with symptoms, as compared to PRISTINE, FONTELIS, SWITCH, INSPIRE, and the untreated check that had 18.9 - 29.7% foliage with symptoms (Table 1). Significant differences among the treatments in disease severity rating and area under the disease progress curve (AUDPC) was observed (Table 1). However, the only difference in the AUDPC among the fungicide treatments was with PRISTINE. No differences in marketable yield or size distribution were found among the treatments (Table 2). However, onion sized was correlated ($r = -0.36$; $P = 0.05$) with percent total leaf length with stemphylium leaf blight symptoms and the AUDPC. 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.

Funding for this project was provided by the Holland Marsh Growers' Association through the support of the Bradford Co-operative Storage Ltd and by the OMAFRA/University of Guelph Partnership.

Table 1. Disease ratings for stemphyllium leaf blight symptoms of onions (cv. Patterson) treated with various fungicides, grown near the Muck Crops Research Station, Holland Marsh, Ontario, 2013.

Treatment	Rate (per ha)	% Total Leaf Length with Symptoms	Plot Rating			AUDPC[1]
			July 25	Aug 2	Aug 9	
QUADRIS TOP	1.0 L	11.8 a[2]	1.0 ns[3]	1.8 a	2.0 a	24.1 a
LUNA TRANQUILITY	1.2 L	13.0 ab	1.5	2.0 a	2.3 ab	28.9 a
DITHANE	3.25 kg	16.1 abc	1.5	2.0 a	2.8 abc	30.6 a
PRISTINE	1.3 kg	18.9 bc	2.0	3.0 b	3.0 bc	41.0 bc
FONTELIS	1.4 L	19.4 bc	1.8	2.3 ab	2.8 abc	33.5 ab
SWITCH	975 g	19.6 bc	1.0	1.8 a	3.5 cd	29.4 a
INSPIRE	512 mL	20.3 c	1.5	2.0 a	2.8 abc	30.6 a
Check	--	29.7 d	1.7	3.0 b	4.3 d	44.4 c

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

Table 2. Comparison of marketable yield and size distribution of onions (cv. Patterson) treated with various fungicides grown near the Muck Crops Research Station, Holland Marsh, Ontario, 2013.

Treatment	Rate (per ha)	Marketable Yield (t/ha)	Size Distribution			
			% Jumbo (> 76 mm)	% Large (64 - 76 mm)	% Medium (45 - 64 mm)	% Cull (< 45 mm)
LUNA TRANQUILITY	1.2 L	61.0 ns[1]	1.3 ns	16.9 ns	58.7 ns	30.7 ns
INSPIRE	512 mL	60.2	0.4	13.1	69.3	21.4
PRISTINE	1.3 kg	58.0	0.4	13.0	72.9	16.4
DITHANE	3.25 kg	56.5	1.8	20.8	63.8	16.0
QUADRIS TOP	1.0 L	52.0	3.2	14.9	59.9	28.7
SWITCH	975 g	49.9	0.4	12.3	67.1	25.6
FONTELIS	1.4 L	44.9	0.4	11.3	61.3	38.2
Check	--	41.9	0.4	8.8	65.8	34.5

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

2013 PMR REPORT #08 SECTION L: VEGETABLE and SPECIAL CROPS – Diseases

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

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TITLE: FUNGICIDE SPRAY TIMING FOR THE MANAGEMENT OF STEMPHYLIUM LEAF BLIGHT IN ONIONS, 2013

MATERIALS: QUADRIS TOP (azoxystrobin 18.2%, difenoconazole 11.4%)

METHODS: In 2013, disease forecasting systems were tested in a field trial conducted in the Holland/Bradford Marsh region of Ontario to determine if disease management could be improved. A randomized complete block design with four replicates per treatment was used. Onion (cv. Patterson) was direct seeded at 34 seeds/m using a Stanhay Precision Seeder on 7 May into organic soil (organic matter ≈ 58%, pH ≈ 7.4) 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, and 5 m in length. Recommended control procedures for weeds and insects were followed. Treatments were:

A. Application of fungicide following Botcast (the botrytis leaf blight forecasting model);
B. Tomcast (forecasting model for early blight, septoria leaf spot and fruit anthracnose) with Disease Severity Value 20;
C. Tomcast with disease severity value 30;
D. Spraying following first time spore is found on spore trap rods;
E. Standard calendar spray schedule; and
F. Untreated check.

For all the treatments, Quadris Top (azoxystrobin 18.2%, difenoconazole 11.4%) fungicide was used. Treatments were applied at different periods based on threshold for spray for each forecasting model used (Tables 1 and 2). Treatments were applied using a CO_2 backpack sprayer equipped with four TeeJet 8002 VS fan nozzles spaced 40 cm apart on a boom and calibrated to deliver 400 L/ha at 240 kPa. 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:

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

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 with visible stemphylium leaf blight symptoms. On 19 September, onions in two 2.32 m sections of row from each replicate were pulled to determine yield. The onions were weighed and graded for size on 31 October. Compared to the previous 10 year averages, air temperatures in 2013 were average for June (18.5°C), July (21.3°C), August (19.6°C) and September (15.3°C), and above average for May (14.8°C). The 10 year average temperatures were: May 12.9°C, June 18.4°C, July 20.7°C, August 19.6°C and September 15.5°C. Monthly rainfall was above the 10 year average for May (113 mm), June (94 mm), July (104 mm), August (87 mm) and September (83 mm). The 10 year rainfall averages were: May 72 mm, June 71 mm, July 82 mm, August 73 mm, September 77 mm and October 60 mm.
Data were analysed using the General Analysis of Variance function of the Linear Models section of Statistix V.10. 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: There were no significant differences in the AUDPC among the treatments, but differences in stemphylium leaf blight severity were found. The fungicide applied at various periods reduced disease severity by 24-34% compared to the untreated check (Table 1). No significant differences were observed in marketable yield or size distribution among the treatments (Table 2) although the Botcast model resulted in numerically lowest yield. Reduction in medium sized onions was correlated ($r = -0.4$; $P = 0.03$) with the AUDPC. The product tested was non-phytotoxic to the crop.

Funding for this project was provided by the Holland Marsh Growers' Association through the support of the Bradford Co-operative Storage Ltd and by the OMAFRA/University of Guelph Partnership.

Table 1. Disease ratings for stemphylium leaf blight symptoms of onions (cv. Patterson) treated with fungicide at different periods, grown near the Muck Crops Research Station, Holland Marsh, Ontario, 2013.

Treatment	Spray date	% Total Leaf Length with Symptoms	Plot Rating			AUDPC[1]
			July 25	Aug 2	Aug 9	
TOMCAST 30	Jul 12, 25 Aug 2, 9, 19	15.5 a[2]	1.3 ns[3]	2.3 ns	3.8 ns	35.0 ns
TOMCAST 20	Jul 3, 22 Aug 2, 9, 19	16.3 a	1.5	2.3	4.0	36.9
Calendar spray	Jul 15, 25 Aug 2, 9, 19	16.3 a	1.3	1.8	3.8	31.3
Spore trap	Jul 15, 25 Aug 2, 9, 19	16.5 a	1.3	2.0	3.8	33.1
BOTCAST	Aug 2, 9, 19	17.9 a	1.5	2.0	4.0	35.0
Check	Not sprayed	23.7 b	1.8	2.8	4.5	43.8

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

Table 2. Comparison of marketable yield and size distribution of onions (cv. Patterson) treated with fungicide at different periods grown near the Muck Crops Research Station, Holland Marsh, Ontario, 2013.

Treatment	Spray date	Marketable Yield (t/ha)	Size Distribution			
			% Jumbo (> 76 mm)	% Large (64 - 76 mm)	% Medium (45 - 64 mm)	% Cull (< 45 mm)
TOMCAST 20	Jul 3, 22 Aug 2, 9, 19	64.5 ns[1]	0.27 ns[1]	16.6 ns	65.9 ns	21.8 ns
Calendar spray	Jul 15, 25 Aug 2, 9, 19	60.9	0.59	13.6	65.6	26.4
TOMCAST 30	Jul 12, 25 Aug 2, 9, 19	54.9	0.66	12.2	61.9	34.1
Check	Not sprayed	49.1	0.50	11.6	62.0	36.2
Spore trap	Jul 15, 25 Aug 2, 9, 19	45.0	0.97	7.5	61.4	46.9
BOTCAST	Aug 2, 9, 19	44.6	1.12	14.6	55.8	43.1

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

2013 PMRR #09 SECTION O: CEREALS, FORAGE CROPS and OILSEEDS-Diseases

CROP: Barley (*Hordeum vulgare* L.), cv. AC Island
PEST: Net Blotch (Pyrenophora teres Drechsler), Scald (Rhynchosporium secalis (Oud.) Davis), and Fusarium Head Blight (FHB) (Fusarium graminearum Schwabe)

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TITLE: EVALUATION OF FOLIAR APPLIED FUNGICIDES FOR CONTROL OF NET BLOTCH, SCALD AND FUSARIUM HEAD BLIGHT IN BARLEY, 2011

MATERIALS: HEADLINE EC (pyraclostrobin 250 g/L), STRATEGO 250 (propiconazole 125 g/L, trifloxystrobin 125 g/L), QUILT (azoxystrobin 75 g/L, propiconazole 125 g/L), TILT 250E (propiconazole 250 g/L), QUADRIS (azoxystrobin 250 g/L), PROLINE (prothioconazole 480 g/L), CARAMBA (metconazole 90 g/L), FOLICUR 3.6F (tebuconazole 432 g/L), and PROSARO (prothioconazole 125 g/L, tebuconazole 125 g/L)

METHODS: Field plots, of the two row barley cultivar AC Island, were established on May 23, 2011, at the Harrington Research Farm of Agriculture and Agri-Food Canada's Crop and Livestock Research Centre on Prince Edward Island. Plots were 5 m long and 10 rows wide, 17.8 cm row width. Each treatment was replicated 4 times in a randomized complete block design. Adjacent to each treatment was an equal sized untreated guard plot of spring wheat (AC Helena). Prior to seeding, plots were broadcast fertilized (May 23) with 17-17-17 (70 kg N/ha). The herbicides REFINE EXTRA (20 g/ha) and MCPA 500 (1 L/ha) with Agral 90 were applied on June 23. Fungicide treatments were applied using a small plot sprayer at desired rates, at 250 L/ha H_20. Scald was rated on July 28 at Zadoks Growth Stage (ZGS) 78 and net blotch was assessed on Aug 81 at ZGS 81. In both cases assessments were made using the Horsfall-Barratt Rating system (0-11) on the 2nd and 3rd leaves of ten randomly selected tillers per plot, and converted to a percentage. Plots were harvested on Sept 7, using a Wintersteiger small plot combine. The mycotoxin deoxynivalenol (DON) was assessed via a ELISA method at the AAFC mycotoxin lab at the Eastern Cereal and Oilseed Research Centre in Ottawa.

RESULTS: Results are presented in Table 1. Only the disease ratings from the third leaf are presented.

CONCLUSION: While disease levels in the untreated control plots were relatively high and the disease control associated with most of the test materials was very good, yields were not significantly impacted by treatment. There was no major difference, for any of the factors assessed, between an early plus late application (ZGS 31 plus 49 versus ZGS 49 alone); with the exception of the QUADRIS plus TILT treatment. The lack of a significant effect on yield may have been a reflection of a relative late occurrence of foliar disease combined with a very good production year and as such reduced environmental stress.

Deoxynivalenol (DON) contamination levels indicated that fusarium head blight (FHB) was an issue in the crop, although there were no visual symptoms on the heads in the field or harvested grain. Application timings in this trial were prior to full head emergence which is earlier than normally associated with FHB fungicide control timings (anthesis). There were no reductions in DON levels and in general there was a tendency for an increase in DON, even though in most cases this was not significant. However, with CARAMBA and PROSARO, and the double application of TILT, there was a significant increase in DON contamination of between 63.4 and 95.5%. This is a result which needs to be further investigated relative to impact on areas where FHB epidemics are an issue.

Table 1. Efficacy of foliar fungicide applications for the control of net blotch, scald and fusarium head blight in the two row barley cultivar AC Island, AAFC – Harrington Research Farm, PEI, 2011.

Treatment	Rate (Product/ha)	Application Timing (ZGS)	Scald [2] (%)	Net Blotch [2] (%)	Yield (kg/ha)	1000 seed Weight (g)	DON (ppm)
Untreated	0		36.4	85.9	3015	44.30	2.2
HEADLINE	400 ml	31 + 49	16.2	47.3	3328	51.05	3.0
HEADLINE	400 ml	49	15.9	59.2	3296	50.10	2.9
STRATEGO 250	500 ml	31 + 49	4.7	5.4	3564	49.38	3.1
STRATEGO 250	500 ml	49	5.2	9.5	3340	47.45	3.0
QUILT	750 ml	31 + 49	3.2	5.2	3466	50.55	3.3
QUILT	750 ml	49	14.0	28.9	3194	49.90	3.0
TILT	500 ml	31 + 49	3.3	5.7	3359	49.30	3.6
TILT	500 ML	49	5.7	6.4	3244	47.40	3.2
FOLICUR	290 ml	31 + 49	5.2	8.3	3415	50.63	2.7
FOLICUR	290 mL	49	5.1	17.6	3203	48.20	2.9
QUADRIS + TILT	225 ml + 500 ml	31 + 49	4.3	13.0	3204	51.58	2.4
QUADRIS + TILT	225 ml + 500 ml	49	22.1	29.5	3294	49.35	3.2
PROLINE [1]	315 ml	31 + 49	3.4	7.8	3478	49.13	2.9
PROLINE [1]	315 ml	49	5.0	8.1	3458	51.83	2.8
CARAMBA	1000 ml	31 + 49	2.6	6.3	3317	48.33	4.3
CARAMBA	1000 ml	49	8.4	9.1	3479	49.65	3.6
PROSARO	800 ml	31 + 49	2.8	5.1	3607	49.75	4.0
PROSARO	800 ml	49	6.7	8.8	3416	51.10	3.8
LSD (0.05)			11.13	17.7	637.7	4.075	1.18
SEM			3.924	6.20	224.90	1.437	0.418

[1] Plus AgSurf at 0.125% v/v

[2] 3rd leaf, scald rated on July 28 and net blotch on Aug 3

2013 PMRR # 10 SECTION O: CEREALS, FORAGE CROPS and OILSEEDS-Diseases

CROP: Canola (*Brassica napus* L.) cv. Invigor 5440
PEST: Sclerotinia Stem Rot (white mold), *Sclerotinia sclerotiorum* (Lib.) de Bary

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TITLE: EVALUATION OF FOLIAR APPLIED FUNGICIDES FOR CONTROL OF SCLEROTINIA STEM ROT OF CANOLA, 2011

MATERIALS: TILT 250E (propiconazole 250 g/L), QUADRIS (azoxystrobin 250 g/L), ABOUND (azoxystrobin 250 g/L), LANCE (boscalid 70%), PROLINE (prothioconazole 480 g/L), ASTOUND (cyprodinil 37.5% and fludioxonil 25.0%) and HEADLINE EC (pyraclostrobin 250 g/L)

METHODS: Field plots of canola, cv. Invigor 5440, were established on May 23, 2011, at the Harrington Research Farm of Agriculture and Agri-Food Canada's Crop and Livestock Research Centre on Prince Edward Island. Plots were 5 m long and 10 rows wide, 17.8 cm row width. Each treatment was replicated 6 times in a randomized complete block design. Adjacent to each treatment plot was an untreated guard plot. Prior seeding, the plot area was broadcast fertilized (May 23) with 20-10-10 (500 kg/ha); plus sulphur at 22.2 kg/ha and liquid Boron at 2 kg/ha prior to incorporation. The pre-plant herbicide BONANZA was applied on May 23, at 2 L/ha, and LIBERTY was applied on June 28, at 2.4 L/ha. Treatments were applied using a small plot sprayer at a 20-25% flowering stage of crop development. Bi-directional Tee-jet 80-3R nozzles were used and delivered at 250 l/ha H_20. Between each spray plot was an equal sized guard plot. Sclerotinia stem rot incidence and severity was rated twice by assessing symptom development on 60 consecutive plants in a row on a 1-9 scale; where 1 = plants are girdled by disease and dead and 9 = no symptoms visible. Plots were harvested on Sept 7, using a Wintersteiger small plot combine.

RESULTS: Results are presented in Table 1.

CONCLUSIONS: Sclerotinia stem rot levels were relatively low in the trial with an incidence of less than 5%. There were no significant effects of any treatment, on either disease incidence or severity. Disease increased between rating dates but since the disease was so variable, in the plot area between treatments and replicates, there were no significant impacts on disease (p=0.05). While not significantly different (p=0.05), the highest yield increases (ca. 9%) were obtained with TILT, PROLINE, and HEADLINE.

Table 1. Efficacy of foliar fungicide applications for the control of Sclerotinia white mould in canola, AAFC – Harrington Research Farm, PEI, 2011.

Treatment	Rate	Sclerotinia stem rot (Aug 18) Incidence	Sclerotinia stem rot (Aug 18) Severity	Sclerotinia stem rot (Aug 25) Incidence	Sclerotinia stem rot (Aug 25) Severity	Yield	1000 Seed Weight
	(Product/ha)	(%)	(1-9)[1]	(%)	(1-9)[1]	(kg/ha)	(g)
Untreated	0	0.6	8.7	3.1	7.0	2327	2.75
TILT	500 ml	1.1	8.4	0.8	8.2	2539	2.75
QUADRIS	310 ml	0.0	9.0	2.2	8.2	2210	2.78
ABOUND	700 ml	1.7	8.5	3.1	8.2	2278	2.79
LANCE	350 g	1.4	8.6	2.5	8.4	2391	2.82
PROLINE	350 ml	0.8	8.5	1.1	8.0	2560	2.80
ASTOUND	775 ml	1.1	8.7	1.9	7.9	2301	2.76
HEADLINE	600 ml	0.8	8.5	4.7	8.1	2533	2.77
HEADLINE + LANCE	600 ml + 350 g	0.3	8.8	1.4	8.3	2540	2.86
LSD (0.05)		ns	ns	ns	ns	ns [2]	ns
SEM		0.61	0.23	1.09	0.38	96.6	0.06

[1] 1-9 scale where 1 is stem completely girdled and dead and 9 healthy plant
[2] Note: not significant at 0.05 but at a 0.094 level of probability

2013 PMRR # 11 SECTION O: CEREALS, FORAGE CROPS and OILSEEDS-Diseases

CROP: Crambe (*Crambe Abyssinica)*
PEST: Sclerotinia Stem Rot (white mold), *Sclerotinia sclerotiorum* (Lib.) de Bary

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TITLE: EVALUATION OF FOLIAR APPLIED FUNGICIDES FOR CONTROL OF SCLEROTINIA STEM ROT OF CRAMBE, ON PEI

MATERIALS: QUADRIS (azoxystrobin 250 g/L), LANCE (boscalid 70%), PROLINE (prothioconazole 480 g/L), and SWITCH 62.5 WP (cyprodinil 37.5%, fludioxonil 25.0%)

METHODS: Field plots of crambe, were established on May 23, 2011, at the Harrington Research Farm of Agriculture and Agri-Food Canada's Crop and Livestock Research Centre on Prince Edward Island. Plots were 5 m long and 10 rows wide, 17.8 cm row width. Each treatment was replicated 6 times in a randomized complete block design, with an equal sized untreated guard plot adjacent to each treatment plot. Prior to seeding, the plot area was broadcast fertilized with 20-10-10 (500 kg/ha) and the pre-plant herbicide BONANZA applied at 1.8 L/ha, on May 23. Fungicide treatments were on applied on July 19th, using a small plot sprayer, at approximately 20-30% bloom and a second application of LANCE was applied to one treatment at 100% bloom. Bi-directional Tee-jet 80-3R nozzles were used and treatments delivered at 250 l/ha H_20. Sclerotinia stem rot incidence and severity was rated on Aug 18th by assessing symptom development on 60 consecutive plants in a row on a 1-9 scale; where 1 = plants are girdled by disease and dead and 9 = no symptoms visible. On Aug 30 the entire plot was assessed on the 1-9 rating scale. Plots were harvested on August 31st, using a Wintersteiger small plot combine.

RESULTS: Results are presented in Table 1. Sclerotinia stem rot was the only major disease evident in the plot area.

CONCLUSIONS: Sclerotinia stem rot levels were very high with an incidence level of 85.3% in the untreated control. By comparison the incidence of sclerotinia stem rot in adjacent canola plots was less than 1%, indicating the very high susceptibility of crambe (specific cultivar unknown) to *Sclerotinia sclerotiorum* infection and development. Early infection level (incidence and severity) assessed on Aug 18th indicated that treatments had only a small impact on sclerotinia stem rot severity but not on incidence. Several of the products did have an impact on disease progression, with evidence of good disease suppression. Most notably was the significant reduction in severity by Aug 30 from PROLINE and SWITCH. LANCE as a single application did not significantly reduce severity but the double application did reduce severity, Aug 30th rating, and was statistically similar to the more efficacious products. Severity of sclerotinia stem rot was evident in the total yield. With the use of control products significant improvement in yields were evident, with the highest increase recorded following the application of PROLINE, at over 120%, which was also reflected in seed weight and hectolitre weights. The double application of LANCE showed no improvement when compared to the single application, despite the severity of the epidemic. QUADRIS was not effective in disease reduction or at improving yield components.

Table 1. Efficacy of foliar fungicide applications for the control of sclerotinia white mould in crambe, AAFC – Harrington Research Farm, 2011.

Treatment	Rate (Product/ha)	Sclerotinia stem rot (Aug 18) Incidence (%)	(Aug 18) Severity (1-9)[1]	(Aug 30) Severity (1-9)[2]	Yield (kg/ha)	1000 Seed Weight (g)	Hectolitre Weight (g)
Untreated	0	85.3	6.7	2.4	1149	5.48	30.62
LANCE	350 g	76.3	6.9	3.8	1984	5.72	31.74
LANCE (x2)[3]	350g + 350g	81.7	6.9	4.8	1837	6.40	33.17
PROLINE	350 ml	70.7	7.1	6.7	2547	6.76	32.99
QUADRIS	700 ml	75.7	7.1	2.6	1362	5.50	30.31
SWITCH	775 g	76.7	7.4	5.4	2197	6.56	33.62
LSD (0.05)		ns	0.55	2.16	579.1	0.784	1.782
SEM		4.22	0.186	0.723	196.3	0.266	0.604

[1] 1-9 scale where 1 is stem completely girdled and plant dead and 9 healthy plant, whole plot severity measurement

[2] Severity on infected plants only

[3] Two applications of LANCE (350 g product each), first at 20% bloom with second at 100% bloom

2013 PMRR # 12 SECTION O: CEREALS, FORAGE CROPS and OILSEEDS-Diseases

CROP: Soybean (*Glycine max*), DH420
PEST: Various

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TITLE: EVALUATION OF SEED TREATMENTS AND FOLIAR APPLIED FUNGICIDES FOR IMPACT ON SOYBEAN PRODUCTION, ON PEI

MATERIALS: Seed treatments - VITAFLO 280 (carbathiin 15.59%, thiram 13.25%), APRON MAXX RTA (fludioxonil 0.73%, metalaxyl-M and S-isomer 1.10%), DYNASTY (azoxystrobin 100 g/L), CRUISER MAX (thiamethoxam 22.6%, metalaxyl-M and S-isomer 1.70%, fludioxonil 1.12%). Foliar sprays - QUADRIS (azoxystrobin 250 g/L), LANCE (boscalid 70%), Ammonium sulphate, HEADLINE EC (pyraclostrobin 250 g/L), TILT (propiconazole 250 g/L), QUILT (azoxystrobin 75 g/L, propiconazole 125 g/L), CARAMBA (metconazole 90 g/L).

METHODS: Field plots of soybeans, cv. DH420, were established on May 31, 2011, at the Harrington Research Farm of Agriculture and Agri-Food Canada's Crop and Livestock Research Centre on Prince Edward Island. Plots were 5 m long and 3 rows wide, 40 cm row width. Each treatment was replicated 4 times in a randomized complete block design, with the foliar fungicide trial there was an equal sized untreated guard plot adjacent to each treatment plot. Seed treatments were applied using a Gustafson small sample seed treater, 1 kg of seed was treated. DYNASTY was mixed with 2.8 ml H_20 prior to treatment. Prior to seeding, the plot area was broadcast fertilized with 17-17-17 (250 kg/ha). A pre-emergent herbicide application was made on June 2 (DUAL at 1.75 l/ha and LINURON 2 L/ha). Foliar fungicide treatments were applied at flowering, using a small plot sprayer with tee-jet nozzles delivering 250 L/ha H_20. Plant stand, stand vigor (seed treatment trial), plant height and height of the lowest pod were measured. Root rot was monitored in the seed treatment trial and foliar and stem disease symptoms monitored in the foliar treatment trial. The entire plot was harvested on November 8th, using a Wintersteiger small plot combine and yields and seed weights determined at 13% moisture.

RESULTS: There was little root rot symptoms apparent in the seed treatment block and no major foliar or stem diseases in the foliar treatment block. Results for the seed treatment trial are presented in Table 1, and for the foliar treatment trial in Table 2.

CONCLUSIONS: Seed Treatment **-** There were no significant effects of any treatment on measured criteria with the exception of yield. All treatments significantly (p=0.05) increased yield, however there was no significance between treatments. Maximum yield increase was obtained with DYNASTY (azoxystrobin), at 20.0%. The significant increase in yield may be an indication that there were root rot issues, which were not evident from visual observations of lower stem and roots. The yield result would indicate that the use of a fungicide seed treatment may be of benefit in soybean production in the region, even if the level of root diseases is potentially low.

Foliar Treatment – In the absence of any major foliar or stem disease symptoms, there was no significant impact (p=0.05) of fungicide application on any of the measured agronomic factors, with the exception of harvest moisture content. Visually there was evidence, of what may have been a physiological effect, from TILT and QUILT (both containing the active ingredient propiconazole); and this was reflected in the harvest moisture results. These treatments were easily discernable in the field as colour change during late growth stages, from yellow to “brown” was 3-4 days following application; and leaf drop also was delayed by several days.

Table 1. Efficacy of fungicide seed treatments in soybeans, cv. DH420, AAFC – Harrington Research Farm, 2011.

Treatment	Rate	Stand	Vigor	Plant Height	Pod Height	Harvest Moisture	Yield	100 Seed wt.
	(Product /ha)	(#/m)	(0-3)[1]	(cm)	(cm)	(%)	(kg/ha)	(g)
Untreated	0	18.8	2.8	56.0	7.3	16.2	2192	19.80
VITAFLO 280	2.6 ml	15.8	3.0	59.3	6.5	16.1	2431	19.72
APRON MAXX RTA	3.25 ml	21.5	2.9	57.5	7.0	16.2	2406	19.25
DYNASTY	0.2 ml	21.3	3.0	59.3	6.0	16.2	2630	19.47
CRUISER MAX	1.95 ml	21.8	3.0	61.5	7.0	16.3	2549	19.92
LSD (0.05)		ns	ns	ns	ns	ns	276.2	ns
SEM		1.541	0.146	1.563	0.456	0.199	89.6	0.342

[3] 0 – 3 scale where 0 = poor overall plot vigor/stand and 3 = excellent overall plot vigor/stand

Table 2. Efficacy of foliar applied fungicides in soybeans, cv. DH420, AAFC – Harrington Research Farm, 2011.

Treatment	Rate	Stand	Vigor	Plant Height	Pod Height	Harvest Moisture	Yield	100 Seed wt.
	(Product /ha)	(#/m)	(0-3)[1]	(cm)	(cm)	(%)	(kg/ha)	(g)
Untreated	0	18.5	2.9	55.0	7.8	14.3	2213	23.80
TILT	500 ml	15.3	2.9	51.3	7.5	15.3	1852	23.68
QUADRIS	500 ml	20.8	2.8	55.8	7.3	14.4	2216	24.30
Ammonium sulphate	20 kg	22.3	2.7	54.0	7.5	14.5	2192	23.03
HEADLINE	500 ml	17.8	2.7	52.5	6.8	14.5	2334	24.70
QUILT	1000 ml	18.5	2.8	55.3	7.5	15.5	1818	24.15
CARAMBA	700 ml	19.5	2.9	51.3	7.5	14.5	2170	23.70
LSD (0.05)		ns	ns	ns	ns	0.56	ns	ns
SEM		1.937	0.065	2.332	0.863	0.192	133.9	0.479

[1] 0 – 3 scale where 0 = poor overall plot vigor/stand and 3 = excellent overall plot vigor/stand

2013 PMRR #13 SECTION O: CEREALS, FORAGE CROPS and OILSEEDS-Diseases

CROP: Winter wheat (*Triticum aestivum* L.), cv. Several
PEST: Fusarium head blight, *Fusarium graminearum* Schwabe
Septoria tritici blotch, *Septoria tritici* Roberge in Desmaz (teleomorph *Mycosphaerella graminicola* (Fuckel) J. Schrot)

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TITLE: EVALUATION OF WINTER WHEAT BREEDING LINES FOR RESISTANCE TO FUSARIUM HEAD BLIGHT (FHB) AND SEPTORIA TRITICI BLOTCH (STB) IN INOCULATED AND MISTED PLOTS

METHODS: The hard red winter wheat breeding lines and parents (‘FTHP Redeemer’ and ‘Maxine’) were planted on October 20, 20012 at Ridgetown, Ontario. The plots were planted in a randomized block design with three replications at 270 seeds/plot, in single rows, spaced 17.8 cm apart. The plots were fertilized and maintained using provincial recommendations. Each plot was inoculated with a combined suspension of macroconidia of two *S. tritici* isolates two times (at tillering and booting stage). At 50% anthesis each plot was also inoculated with a combined suspension of macroconidia of four *Fusarium graminearum* isolates. Plots were misted daily beginning after the first plots were inoculated. The overhead mister was set to run from 11:00-16:00 and misted for approximately 60-90 seconds every 8-10 minutes. The mist system was engaged until three days after the last variety was inoculated with *F. graminearum*. Septoria tritici blotch (STB) severity was rated on 0-9 scale and fusarium head blight (FHB) symptoms were recorded as incidence (percent of heads infected) and severity (percent of spikelets infected). FHB severity was estimated according to Stack and McMullen (1995). FHB index for each plot was the product of severity and incidence divided by 100. Deoxynivalenol (DON) concentration was determined by ELISA method using a commercial kit from Diagnostix with the limit of detection of 0.1 ppm.

RESULTS: The results are given in the Table 1.

CONCLUSION: Inoculations with *S. tritici* and *F. graminearum* successfully provided a wide range of symptoms for both diseases. Average STB severity across the lines was 3.6; line CA03-084 had the lowest STB severity (1.7). Line CA03-059 had the highest STB severity (5.0), FHB index (77.7%) and DON level (17.3 ppm), while line CA03-006 had the lowest FHB index (30.9%) and DON level (6.7 ppm) in addition to one of the lowest STB ratings. There was no significant relationship between the

FHB index ratings and the subsequent DON contamination. There was only limited significant differences between cultivars for DON.

ACKNOWLEDGEMENT: Funding for this project was provided by the Grain Farmers of Ontario and AAFC under CAAP program.

Table 1. Septoria tritici blotch severity, fusarium head blight index and DON level across hard red winter wheat breeding lines in inoculated and misted plots at Ridgetown, Ontario. 20012-2013.

Line	Septoria leaf (0-9)	FHB index (%)	DON (ppm)
CA03-006	2.0	30.9	6.7
CA03-016	4.0	46.2	11.8
CA03-017	4.3	76.5	11.2
CA03-022	4.0	56.7	10.6
CA03-023	5.0	67.7	9.8
CA03-041	1.8	59.9	9.9
CA03-046	3.8	55.3	7.7
CA03-047	4.3	62.5	8.9
CA03-052	4.0	66.6	10.1
CA03-054	4.0	55.3	11.0
CA03-058	3.0	41.4	11.2
CA03-059	5.0	77.7	17.3
CA03-068	3.3	62.4	13.5
CA03-070	3.0	32.2	13.7
CA03-078	3.8	45.7	14.7
CA03-080	4.0	68.7	14.5
CA03-084	1.7	66.2	9.1
CA03-085	4.5	72.0	8.6
CA03-091	4.5	67.5	12.8
CA03-094	4.3	75.3	10.4
CA03-101	3.0	66.6	8.7
CA03-110	4.0	49.7	14.0
FTHP Redeemer	5.0	64.2	9.9
Maxine	3.0	60.5	10.7
LSD (P=.05)	0.8	14.1	6.1
Standard Deviation	0.6	10.0	2.9
CV	15.7	16.7	26.4
Grand Mean	3.6	59.8	11.1

CROP: Winter wheat (*Triticum aestivum* L.), cv. Princeton
PEST: Fusarium head blight, *Fusarium graminearum* Schwabe
Powdery mildew (*Blumeria graminis* (DC.) Speer f. sp. tritici emend. É.J. Marchal)
Septoria tritici blotch (*Mycosphaerella graminicola* (Fuckel) J. Schröt.)

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TITLE: THE EFFECT OF FUNGICIDE AND NITROGEN ON AGRONOMY, DISEASES, MYCOTOXINS LEVEL AND QUALITY OF 'PRINCETON' WHEAT

MATERIALS: PROLINE (prothioconazole 480 g/L), QUILT (azoxystrobin 75 g/L plus propiconazole 125 g/L), PROSARO (prothioconazole 125 g/L plus tebuconazole 125 g/L)

METHODS: Experimental plots of hard red winter wheat 'Princeton' were planted in October 2012 at Ridgetown, Ontario. Treatments were organized as a randomized complete block design in a factorial arrangement across 4 replications. The treatments included three spring N rates (75, 100, and 125 kg N ha^{-1}) and three fungicide regimes consisting of an untreated control, QUILT + PROSARO with QUILT (750 ml product/ha) applied at flag leaf stage (Zadoks Growth Stage ZGS 39) followed by PROSARO (800 ml product/ha) applied at 50% anthesis (ZGS 60), or PROLINE (315 ml product/ha) applied at GS 60. Each plot was 1.15 m by 4.00 m. N was broadcast applied by hand in the spring as calcium ammonium nitrate. Fungicides were applied with a CO_2-pressurized backpack sprayer calibrated to 200 L ha^{-1}. Three flat-fan nozzles spaced 0.50 m apart were used for application. Disease severity for powdery mildew and septoria tritici blotch were estimated when present by visually rating the plots on a 0-9 scale. Fusarium head blight (FHB) symptoms were recorded as incidence (percent of heads infected) and severity (percent of spikelets infected). Severity was estimated according to Stack and McMullen (1995). FHB index for each plot was the product of severity and incidence divided by 100. Deoxynivalenol (DON) concentration was determined by GC-MS method with the limit of detection of 0.1 ppm. Grain was harvested by a small plot combine and reported at 14% moisture content. Protein contents and fusarium damaged kernels (FDK) level were measured using a SpecStar 2500-X Near Infrared (NIR) Analyzer (Unity Scientific Inc., Purcellville, Virginia).

RESULTS: The results are given in the Table 1.

CONCLUSION: There was no significant interaction between N rates and fungicide application for any trait. Both fungicides treatments resulted in increased yield at the 100 kg/ha N component and decreased FHB index at all N levels, when compared to the repective control. Average FDK and DON level across all treatments was 7.5 % and 1.2 ppm, respectively. There was a significant relationship between FDK severity and DON levels; with a tendency for increasing N to increase FDK severity and fungicide application to slightly reduce severity by 30-40% with QUILT+PROSARO. QUILT+PROSARO significantly decreased powdery mildew levels under all nitrogen levels, while PROLINE only reduced the level at the 75 kg/ha N rate. Protein level in grain was significantly reduced by the QUILT+PROSARO treatment at the lowest N level (75 kg/ha), when compared to respective control. The highest grain protein level (13.9%), highest FDK (10.5%) and DON level (2 ppm) was obtained after application of 125 kg/ha of N and without fungicides application.

ACKNOWLEDGEMENT: Funding for this project was provided by the Grain Farmers of Ontario and AAFC under CAAP program.

Table 1. Diseases ratings, yield, grain protein, FDK and DON level as affected by fungicide and nitrogen application in 'Princeton' wheat at Ridgetown, Ontario. 20012-2013.

	Treatment	Powdery mildew (0-9)	Septoria leaf (0-9)	FHB Index (%)	Yield (kg/ha)	Grain protein (%)	FDK (%)	DON (ppm)
1	75 kg/ha N control	3.0	3.0	3.8	4651.6	13.3	7.7	1.4
2	75 kg/ha N PROLINE	1.8	2.3	2.8	5285.9	13.0	6.7	1.0
3	75 kg/ha N QUILT+PROSARO	1.3	2.8	2.5	4742.4	12.7	4.5	1.0
4	100 kg/ha N control	3.0	3.3	3.8	3916.8	13.6	9.2	1.7
5	100 kg/ha N PROLINE	2.3	3.3	2.0	4668.5	13.3	7.7	1.1
6	100 kg/ha N QUILT+PROSARO	1.8	2.5	2.5	5169.0	13.3	6.6	0.7
7	125 kg/ha N control	2.5	2.8	4.5	4681.5	13.9	10.5	2.0
8	125 kg/ha N PROLINE	2.5	2.8	2.8	5094.6	13.7	7.0	1.3
9	125 kg/ha N QUILT+PROSARO	1.5	2.3	2.0	5274.5	13.5	7.4	0.8
LSD (P=.05)		0.8	0.7	0.9	644.4	0.4	3.6	1.1
Standard Deviation		0.6	0.5	0.6	441.5	0.3	2.4	0.5
CV		26.1	17.4	21.8	9.1	2.2	32.6	39.8
Mean		2.2	2.8	2.9	4831.6	13.4	7.5	1.2

CROP: Winter wheat (*Triticum aestivum* L.), cv. Several
PEST: Fusarium head blight, *Fusarium graminearum* Schwabe
Septoria tritici blotch, *Septoria tritici* Roberge in Desmaz (teleomorph *Mycosphaerella graminicola* (Fuckel) J. Schrot)

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TITLE: EVALUATION OF WINTER WHEAT BREEDING LINES FOR RESISTANCE TO FUSARIUM HEAD BLIGHT (FHB), DEOXYNIVALENOL LEVEL, FDK LEVEL AND SEPTORIA TRITICI BLOTCH (STB) IN INOCULATED AND MISTED PLOTS

METHODS: The winter wheat breeding lines from the cross between RCUOGF110202D/4 and DVS 720500 were planted on October 20, 20012 at Ridgetown, Ontario. Both parents have high level of resistance to FHB and were the two most resistant genotypes tested in Canada and Germany over several years and locations. The plots were planted in a randomized block design with three replications at 270 seeds/plot, in single rows, spaced 17.8 cm apart. The plots were fertilized and maintained using provincial recommendations. Each plot was inoculated with a combined suspension of macroconidia of two *S. tritici* isolates two times (at tillering and booting stage). At 50% anthesis each plot was also inoculated with a combined suspension of macroconidia of four *Fusarium graminearum* isolates. Plots were misted daily beginning after the first plots were inoculated. The overhead mister was set to run from 11:00-16:00 and misted for approximately 60-90 seconds every 8-10 minutes. The mist system was engaged until three days after the last variety was inoculated with *F. graminearum.* Septoria tritici blotch (STB) severity was rated on 0-9 scale and fusarium head blight (FHB) symptoms were recorded as incidence (percent of heads infected) and severity (percent of spikelets infected). FHB severity was estimated according to Stack and McMullen (1995). FHB index for each plot was the product of severity and incidence divided by 100. Deoxynivalenol (DON) concentration was determined by ELISA method using a commercial kit from Diagnostix with the limit of detection of 0.1 ppm. Protein contents and fusarium damaged kernels (FDK) level were measured using a SpecStar 2500-X Near Infrared (NIR) Analyzer (Unity Scientific Inc., Purcellville, Virginia).

RESULTS: The results are given in the Table 1.

CONCLUSION: Inoculations with *S. tritici* provided a wide range of symptoms; average STB severity across the lines was 5.5. Line 56 had the lowest STB severity (3.7) and was significantly different from lines 2 and 35 which had the highest STB severity (7.3 and 7.7, respectively). Inoculations with *F. graminearum* also provided a wide range of FHB symptoms, DON and FDK levels. In addition to resistance to *S. tritici,* line 56 had the lowest FHB index (1.8%) indicating that screening for two diseases in the same nursery was a good strategy that could potentially results in development of lines resistant to both diseases in a shorter period of time. Line 27 had the lowest DON level (1.5 ppm), while line 6 had the lowest FDK level (5.6%). There was no relationship between FHB symptoms and DON or FDK level in harvested grain across the lines. The results indicated that in addition to screening for FHB visual symptoms, breeding for Fusarium resistant line needs to incorporate screening for DON accumulation and/or FDK level in the harvested grain.

ACKNOWLEDGEMENT: Funding for this project was provided by the Grain Farmers of Ontario.

Table 1. Septoria tritici blotch severity, fusarium head blight index, DON level and FDK level across winter wheat breeding lines in inoculated and misted plots at Ridgetown, Ontario. 20012-2013.

Line	Septoria (0-9)	FHB Index (%)	FDK (%)	DON (ppm)	Line	Septoria (0-9)	FHB Index (%)	FDK (%)	DON (ppm)
1	5.7	34.1	12.9	6.5	61	4.7	35.6	10.6	8.5
2	7.3	60.5	13.8	6.3	62	5.3	7.6	9.8	16.4
3	4.3	10.1	7.9	4.5	63	5.0	10.0	10.0	14.2
4	5.7	9.7	12.1	5.3	64	5.3	8.8	7.5	6.7
5	4.0	8.6	14.7	8.8	65	5.7	7.6	7.4	5.0
6	4.3	2.9	5.6	3.3	66	6.3	10.1	9.8	10.2
7	4.7	11.8	10.1	9.6	67	6.3	5.4	11.3	10.1
8	5.0	10.8	11.5	8.7	68	4.3	5.0	12.0	8.9
9	5.3	25.0	6.6	1.8	69	5.3	27.9	9.3	4.9
10	4.7	21.9	10.5	4.0	70	4.3	3.1	9.0	7.4
11	6.0	21.1	9.8	4.2	71	4.7	15.0	10.7	10.8
12	6.0	20.9	12.3	9.0	72	6.7	8.9	10.4	5.9
13	6.7	30.9	8.7	7.4	73	4.7	10.9	9.7	4.4
14	4.7	6.1	11.7	5.7	74	5.0	6.8	9.1	6.4
15	4.7	11.8	13.3	11.5	75	4.3	33.0	9.0	4.0
16	4.0	18.0	15.0	8.2	76	5.0	11.0	7.2	5.8
17	6.0	29.9	11.6	3.9	77	6.0	42.5	10.8	9.3
18	6.7	13.5	6.3	3.5	78	5.3	4.2	7.3	11.5
19	6.3	14.9	10.7	4.7	79	6.7	18.7	9.9	4.5
20	7.0	19.4	10.7	5.6	80	5.7	14.2	12.2	9.4
21	5.3	37.3	12.4	5.9	81	6.0	35.2	10.6	8.5
22	5.0	35.2	9.2	5.2	82	5.7	3.5	8.6	9.4
23	5.3	26.1	9.3	7.8	83	4.7	16.1	7.8	9.8
24	4.3	6.6	11.8	6.7	84	5.5	24.2	7.6	12.3
25	6.3	5.8	8.1	3.8	85	5.3	27.3	12.7	9.2
26	6.7	39.4	14.9	6.6	86	5.7	20.9	12.8	12.5
27	5.3	2.1	6.5	1.5	87	5.3	24.9	11.6	11.1
28	6.7	34.1	9.8	7.1	88	6.0	11.0	11.2	19.0
29	6.0	25.3	9.9	8.2	89	7.0	12.8	10.1	8.8

30	6.0	8.6	11.0	8.9	90	5.3	9.9	9.9	6.1
31	6.7	33.1	11.8	8.4	91	6.0	22.1	10.9	7.7
32	4.7	2.1	6.7	2.8	92	4.7	4.0	11.5	6.0
33	5.3	29.9	13.8	16.3	93	6.0	3.2	7.6	4.2
34	5.0	26.2	9.5	13.4	94	5.3	17.6	13.9	13.8
35	7.7	22.4	8.7	5.0	95	4.3	5.1	13.3	10.1
36	4.3	4.8	9.3	9.7	96	5.0	21.6	13.6	8.6
37	5.0	16.4	10.3	9.1	97	5.7	16.3	12.0	7.6
38	5.7	6.5	12.2	6.1	98	7.3	34.2	13.7	13.1
39	5.0	40.4	9.8	8.2	99	6.3	24.8	13.2	8.1
40	6.0	21.2	10.0	14.9	100	6.3	2.7	6.6	2.4
41	7.0	12.1	10.4	11.0	101	5.7	5.1	7.5	7.7
42	5.3	11.5	8.8	5.5	102	5.0	3.5	9.7	11.0
43	6.7	16.1	9.0	7.7	103	7.0	18.5	12.0	2.7
44	6.0	29.0	10.1	10.3	104	5.3	16.0	11.5	12.5
45	6.3	32.3	9.1	7.5	105	5.7	7.5	8.6	9.0
46	6.7	23.2	13.5	13.4	106	6.0	6.2	10.6	6.3
47	5.7	21.1	9.0	9.4	107	6.7	14.3	11.1	7.5
48	5.3	11.0	9.3	8.2	108	5.7	4.6	12.3	13.3
49	4.7	25.3	9.0	11.9	109	4.0	10.9	12.2	10.1
50	5.0	18.9	12.0	8.3	110	5.3	3.2	11.7	6.3
51	4.7	26.2	13.3	6.2	111	5.3	3.7	7.7	7.2
52	4.7	10.2	7.3	5.7	112	5.0	16.6	9.6	10.4
53	6.0	3.8	6.2	3.2	113	5.7	26.6	10.0	8.7
54	5.3	20.9	9.4	6.7	114	4.7	4.7	11.1	10.7
55	5.7	12.1	8.2	3.2	115	4.7	8.7	10.7	13.0
56	3.7	1.8	10.2	4.7	116	6.3	2.4	8.2	3.4
57	4.0	3.6	8.4	4.7	117	4.7	20.9	11.9	13.8
58	5.3	11.6	11.9	8.2	118	6.3	7.9	12.4	3.4
59	6.3	11.9	9.1	8.1	119	6.3	15.2	7.9	7.9
60	6.3	38.8	12.6	13.2					
LSD (P=.05)			21.8	5.7					
Standard Deviation			13.6	3.5					
CV			82.5	44.1					
Mean			16.5	8.0					