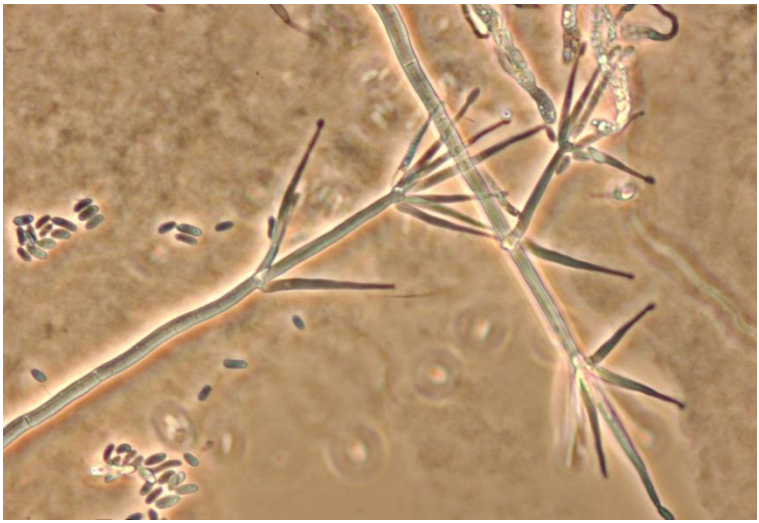
CANADIAN PHYTOPATHOLOGICAL SOCIETY

MARITIME REGION MEETING 2012



Atlantic Food and Horticulture Research Centre
Agriculture and Agri-Food Canada
Kentville, Nova Scotia

December 4, 2012

Canadian Phytopathological Society

Maritime Region Meeting
December 4, 2012
Atlantic Horticulture and Food Research Centre, Kentville, NS

INTRODUCTION

Welcome to Kentville and to the 2012 Canadian Phytopathological Society Maritime Region Meeting. It has been a full year since we got together as a group, and I look forward to a stimulating afternoon of scientific discussion and fellowship.

There are 13 oral presentations and 2 poster presentations on various topics in phytopathology scheduled for the afternoon. A dinner and presentations will take place at **The Port Pub and Bistro** following the meeting.

I am pleased and honoured to welcome Dr. Solke De Boer, retired scientist with the Canadian Food Inspection Agency in Charlottetown, as our keynote speaker. Dr. De Boer is world-renowned for his work in the area of plant bacteriology and bacterial detection and has made many outstanding contributions in his field of research. His presentation is entitled: 'Plant Pathogen Detection.'

Many thanks to all who attended the meeting. I would particularly like to thank Drs. Paul Hildebrand and Gordon Braun, AAFC, Kentville, for hosting this year's meeting and taking on the responsibilities of organizing the meeting, scheduling the presentations and preparing the book of abstracts. I would also like to thank the Canadian Phytopathological Society, represented by Dr. Fouad Daayf, for sponsoring this event. I trust we will be able to get together on a regular basis in future, and on that note, we will host the 2013 meetings in Charlottetown, PE.

This booklet contains abstracts of oral and poster presentations in the order that they were presented. All abstracts will subsequently be published in an upcoming edition of the Canadian Journal of Plant Pathology. The research work represented by these papers forms an important part of the on-going development of phytopathological research in the Maritimes.

Rick D. Peters
CPS Maritime Region Rep

Canadian Phytopathological Society
Annual Maritime Region Meeting – 2012

Scientific Program
Tuesday, December 4
Cornwallis Room – Atlantic Food & Horticulture Research Centre, Kentville, NS

1:00-1:10 **Welcome: Rick D. Peters,** CPS Rep-Maritime Region

1:10-1:45 **Keynote Speaker: Dr. Solke De Boer**
Plant pathogen detection

Session A: Bacteria

1:45-2:00 Tomato as a latent carrier of '*Ca. Liberibacter solanacearum*', the causal agent of potato zebra chip disease.
Sean Li, J. Nie, H. Arsenault, S.H. De Boer

2:00-2:15 Central American origin of the bacterial pathogen causing Pierce's disease of grape.
Kat Yuan, L. Nunney and R. Stouthamer

2:15-2:30 Managing potato common scab in the field using biopesticides, soil additives or soil fumigants.
Khalil I. Al-Mughrabi, A. Vikram, R. Poirier and K.E. Jayasuriya

Session B: Viruses

2:30-2:45 Standardized RT-PCR procedures for detecting common viruses in potatoes.
Huimin Xu, S. Cody, and R. Thibodeau-Doyle

2:45-3:00 PVY strains detected between 2010 and 2012 on Prince Edward Island.
Huimin Xu, R. Coffin, B. Beaton, R. Thibodeau-Doyle and S. Cody

3:00-3:30 **Nutrition Break and Poster Session**

Session C: Posters

Seasonal release of conidia of *Valdensia heterodoxa* and disease progress in lowbush blueberry.
Paul Hildebrand and W. E. Renderos

Mannitol's mode of action against angular leaf spot of strawberry.
Gordon Braun and P. Hildebrand

Session D: Fungal Pathogens

3:30-3:45 Assessing pathogenicity and chemical sensitivity of *Fusarium* spp. infecting carrots.
Michelle MacDonald, R.D. Peters, J. Driscoll, G. Dykermans, S. Adams, A. Ryan, C. Banks, A. MacPhail, D. Gregory and K.A. Drake

3:45-4:00 Evaluation of seven tomato varieties for field resistance to late blight (*Phytopthora infestans).*
Robert Coffin, J. Coffin, R. Peters, K. Drake, D. Gregory, M. MacDonald, A. MacPhail, G. Wang-Pruski, B. Beaton, C. Banks, L. Kawchuck and A. Melish

4:00-4:15 Assessment of in-furrow application of Vertisan ^{TM} (penthiopyrad) fungicide for control of *Rhizoctonia* (black scurf) and common scab in three varieties of potatoes.
Robert Coffin, J. Coffin, R. Peters, K. Drake, B. Beaton and B. Fraser

4:15-4:30 Discovery of resistance to metalaxyl-m in populations of *Phytophthora erythroseptica* causing pink rot of potato in Prince Edward Island.
Rick Peters, B.W. Beaton, M.M. Clark, B. Forrester, A. MacPhail, K.A. Drake, D. Gregory and M.M. MacDonald

4:30-4:45 Phosphite for late blight control in potato production – Update of the CHC project.
Gefu Wang-Pruski, R. Coffin, R. Peters, Z. Ganga, K. Al-Mughrabi, B. Prithiviraj and D. Pinto

4:45-5:00 How fast, how many and for how long: deciphering the defense mechanisms induced by phosphite-based fungicides in potatoes.
Tudor Borza, Y. Wang and G. Wang-Pruski

5:00-5:15 Phosphites affect mycelial growth and induce morphological changes in *Phytophthora infestans*.
Xingxi Gao, G. Sakthivel, T. Borza, Y. Wu and G. Wang-Pruski

5:15-5:30 **Wrap-up**

6:30-10:00 **Dinner and Awards**

Plant pathogen detection. S.H. DE BOER, Emeritus. *Canadian Food Inspection Agency, Charlottetown, PE C1A 5T1, Canada*

There is a great need for accurate means to detect plant pathogens because such methods play a major role in bringing to market healthy seed, tubers, bulbs, rootstocks, cuttings, etc., mitigating pathogen spread in both domestic and international trade, and the implementation of disease control strategies. Technologies used for detection of plant pathogens are under rapid development and coincide considerably with those that are also needed for diagnosing plant diseases and identifying pathogenic microorganisms. Over the last century, particularly over the last 30 or so years, detection methods have evolved from simple visual observation to sophisticated antibody- and nucleic acid-based tests. Methodologies such as those employing lateral flow devices have led the way in on-the-spot testing capabilities. While hand-held nucleic acid amplifying devices based on PCR technology are available, they are likely to be replaced by simplified devices based on one of several isothermal amplification technologies. Multiplex detection techniques including antibody and nucleic acid arrays on membrane platforms and ingeniously labelled beads in aqueous formats form the base of sophisticated methods suitable for screening large number of samples in a laboratory setting. Additionally bar-coding and other DNA sequencing strategies may yet also play a role in future detection methods. Notwithstanding the sophistication of new technologies, questions related to their appropriate usage, particularly for high impact pathogens that cannot be isolated or visualized, remain a challenge with the need to anticipate when and where confirmatory and verification tests of primary test results will be required.

Tomato as a latent carrier of '*Ca.* Liberibacter solanacearum', the causal agent of potato zebra chip disease. X. LI, J. NIE, H. ARSENAULT, AND S. H. DE BOER. *Canadian Food Inspection Agency, Charlottetown Laboratory, 93 Mt Edward Road, Charlottetown, PE C1A 5T1, Canada*

'*Candidatus* Liberibacter solanacearum' (CLS) has been identified as the causal agent of potato zebra chip (ZC) disease that is characterized by severe internal necrosis of potato tuber tissue, and results in millions of dollars in losses to potato growers annually. The disease occurs in North America from Mexico to the northern US, and in Guatemala, New Zealand, and northern Europe on various crops. In order to prevent the spread of the pathogen, the European Plant Protection Organization (EPPO) recently added CLS to the EPPO A1 list of quarantine pests. Comparison and observation of both ZC-infected tomato and potato plants propagated in growth rooms indicated that tomato (varieties Money Maker and Roma) can be a latent carrier of CLS. Tomato plants graft-inoculated with scions from latently infected tomato plants remained symptomless, but tested positive in a ZC-specific PCR assay. CLS was consistently detected in the top, medium and bottom portion of symptomless tomato plants, including petiole, midrib, flowers and fruit. This is the first report that CLS is present in tomato flowers and fruit, leading to speculation that the disease may be seed-borne. Furthermore, plants of five potato cultivars showed typical symptoms of purple top and leaf scorch four weeks after being grafted with scions from the asymptomatic tomato plants. Tubers from the graft-inoculated potato plants also showed typical symptoms of brown discoloration in the vascular ring and medullary rays. While CLS could not be detected in the aerial tubers of graft-inoculated greenhouse-grown plants, it was readily detected in the stems and progeny tubers of the same plants.

Central American origin of the bacterial pathogen causing Pierce's disease of grape. K. YUAN, L. NUNNEY AND R. STOUTHAMER. *(K.Y.) University of California, Riverside (UCR), 900 University Ave, Riverside, CA 92521, USA; (K.Y., L.N., R.S.) Canadian Food Inspection Agency, Charlottetown Laboratory, 93 Mt Edward Road, Charlottetown, PE C1A 5T1, Canada*

Pierce's disease of grape is caused by X*ylella fastidiosa* subsp fastidiosa (XF) that infects the xylem vessels of grapevine, and has long posed a serious threat to the wine industry in the United States. To elucidate the evolution and origin of the pathogen, the multi-locus sequence typing (MLST) method based on seven housekeeping gene sequences (4161 bp) was used to identify and group 86 isolates of XF from across the US. We also compared two whole genomic sequences of XF (isolates Temecula-1 and M23), and detected limited genetic variations between them. Although XF is generally assumed to be native to the US, our data suggests that all XF strains in the US are derived from elsewhere. This hypothesis is supported by the fact that the US genotypes nest together within the phylogenetic grouping of 24 Costa Rican isolates of XF, which have extensive genetic variation. The level of variation found among the US strains is consistent with derivation from a single common ancestor within the last 150 years. Rather than being native to the US, a single introduction of the pathogen into the US possibly occurred in the period of 1850-1870 when known hosts such as coffee plants were brought to US from Central America.

Managing potato common scab in the field using biopesticides, soil additives or soil fumigants. K.I. AL-MUGHRABI, A. VIKRAM, R. POIRIER, AND K.E. JAYASURIYA.
Potato Development Centre, New Brunswick Department of Agriculture, Aquaculture and Fisheries, 39 Barker Lane, Wicklow, NB E7L 3S4, Canada

Two field trials were conducted in 2008 and 2009 at McCain's Research Farm, Florenceville-Bristol, New Brunswick, Canada to assess the efficacy of *Bacillus subtilis*, *Enterobacter cloacae*, Chloropicrin, Pic-Plus, manganese sulfate and mustard meal against common scab of potato caused by *Streptomyces scabiei*. The trials consisted of the following treatments, each replicated four times: [1] control; [2] seed treated with a 2.8% solution of *B. subtilis* (7.3×10^9 CFU g^{-1}) applied at 1 mL/seed; [3] seed treated with a solution of *E. cloacae* (10^8 CFU mL^{-1}) in nutrient broth applied at 0.3 ml/seed; [4] seed dusted with fludioxonil applied at 500 g/100 kg of cut seed; [5] seed dusted with mancozeb applied at 882 g/100 kg of cut seed; [6] mustard meal applied to soil at 1065 kg ha^{-1} 3 days prior to planting; [7] manganese sulfate applied to soil at 75 kg ha^{-1} at planting; [8] Pic-Plus injected to soil at 64 L ha^{-1}; and [9] chloropicrin 100 injected to soil at 55 L ha^{-1}. Disease severity was significantly reduced due to seed treatments with *B. subtilis* or fludioxonil or due to the addition of mustard meal to the soil. The same three treatments increased marketable yield by 32.5%, 24.6% and 24.6%, respectively. These findings indicate the potential of biopesticides and soil additives in managing common scab of potatoes.

Standardized RT-PCR procedures for detecting common viruses in potatoes. H. XU, S. CODY, AND R. THIBODEAU-DOYLE.
Canadian Food Inspection Agency, Charlottetown Laboratory, 93 Mount Edward Road, Charlottetown, PE C1A 5T, Canada

Over 50 viruses have been reported to infect potato naturally and 10 of them have been confirmed to present in commercial potato lots in Canada. They are potato viruses A, M, S, X, Y (PVA, PVM, PVS, PVX, PVY), *Potato leafroll virus* (PLRV), *Potato mop-top virus* (PMTV),
Potato latent virus (PLV), *Tobacco rattle virus* (TRV) and Alfalfa mosaic virus (AMV). There is a requirement for detecting some or all these viruses in nuclear stock production in Canada and seed potato trade with some countries. Primers and probes specific to these viruses were produced based on sequence analysis in this study or according to the published data and evaluated for their sensitivity and specificity for detecting RNA sequences of these viruses in various potato tissues including leaves, sprouts, microplantlets and tubers. Three to ten isolates of each virus were used in the specificity tests. Serial dilutions of extracted RNA and composite samples (w/w or v/v) were tested by conventional and real-time RT-PCR for determining the sensitivity of the primers and probes in PCR. Procedures for RNA extraction were standardized based on cost-efficiency, quality of RNA extracts and quantity of RNA yield. Viral RNA in dormant potato tubers was readily detected without the need to break tuber dormancy and testing results of seed tubers and grown out plants agreed perfectly. Virus was easily detected in composite samples of 200 (for PVY, PLRV, PVS, PMTV and TRV) to 400 (for PVA, PVX, PVM, PLV and AMV) dormant tubers. Standard protocols were developed, optimized and standardized followed by repeatability and reproducibility tests. The RT-PCR procedures (duplex/multiplex) developed, have been employed successfully for screening field tuber samples for seed potato certification.

PVY strains detected between 2010 and 2012 on Prince Edward Island. H. XU, R. COFFIN, B. BEATON, R. THIBODEAU-DOYLE, AND S. CODY. (*H.X., R.T-D., S.C) Canadian Food Inspection Agency, Charlottetown Laboratory, 93 Mount Edward Road, Charlottetown, PE C1A 5T, Canada; (R.C.) Potato Consulting Services Inc., 909 Eliot River Rd., North Wiltshire, PE C0A 1Y0, Canada; and (B.B.) Prince Edward Island Department of Agriculture and Forestry, 440 University Ave., Charlottetown, PE C1A 4N6, Canada*

Potato virus Y (PVY) has a single strand, plus sense RNA as its genome. Like many other RNA viruses, PVY displays a high degree of genetic variability mainly due to RNA recombination between different strains in mixed infections. To date, many distinct PVY strains and sub-strain variants have been detected and characterized and some of them, including PVY^{O}, PVY^{N}, PVY^{NTN} and $PVY^{N\text{-}Wi}$ (also known as $PVY^{N:O}$) have been detected in Canada. Isolates of PVY^{O} have been the most prevalent in North America and accounted for approximately 70% of all PVY isolates. However, a survey conducted from 2010 to 2012 showed that isolates of the common strain in the province of Prince Edward Island (PEI) only accounted for 30% to 40% of over 1000 PVY isolates detected. The traditional PVY^{N} strain was not detected in this survey. Among the 1000 PVY isolates detected in PEI, the PVY^{NTN} strain accounted for 30% and the recombinant strain type, $PVY^{N\text{-}Wi}$ accounted for about 20%. Most of the PVY^{NTN} isolates detected in this survey were identified as European (EU) type of PVY^{NTN}. Visual inspection revealed that plants of common potato cultivars infected with PVY^{NTN} and $PVY^{N\text{-}Wi}$ isolates developed only mild symptoms (mosaic/mottling) and might produce tubers showing symptoms of potato tuber necrotic ringspot disease (PTNRD). Over 50% of the tubers harvested from Yukon Gold plants infected with PVY^{NTN} (both primary and secondary infection) showed PTNRD symptoms at harvest and a disease index (0 to 1) as high as 0.8 based on external necrosis of all symptomatic tubers. In the survey, all potato samples (tubers and leaves) were screened by RT-PCR for all PVY strain types followed by multiplex RT-PCR for strain typing. RFLP and sequence analysis was also performed for verifying PCR amplicons for proper identification.

Seasonal release of conidia of *Valdensia heterodoxa* and disease progress in lowbush blueberry. P.D. HILDEBRAND AND W.E. RENDEROS. *Atlantic Food and Horticulture Research Centre, Agriculture and Agri-Food Canada, 32 Main St. Kentville, NS B4N 1J5, Canada*

Valdensinia leaf spot of lowbush blueberry is caused by the anamorph *Valdensia heterodoxa* (Peyr.) of the ascomycetous fungus *Valdensinia heterodoxa* (Peyr.). Initial inoculum originates as unusually large conidia (400-600 µm) formed directly on sclerotia in colonized leaves of the previous season. Conidia are forcibly propelled upward and infect leaves resulting in large lesions, premature defoliation and subsequent production of new conidia. Commercial blueberry growers typically become concerned when they first observe the disease in late June or early July. In 2010 and 2011, we monitored the seasonal release of conidia and disease progress in fruiting and sprout fields with the aim to improve timing of fungicide applications. Conidia were trapped on Petri dish lids suspended 15 cm above ground level. In early May, the ground beneath the traps was seeded once with leaves bearing sclerotia. Traps were changed at intervals of 5-10 days throughout the season and conidia were counted with a stereomicroscope. Disease progress was monitored at intervals in control plots of replicated fungicide trials. In fruiting fields, the incidence of affected leaves (dropped plus infected but attached) was assessed on lower, middle and upper leaf shoots while in sprout fields, the incidence of affected leaves was assessed on the entire stem. In fruiting fields, first conidia were trapped in late May and several days later in sprout fields in both years. In 2010, disease onset occurred a few days after initial conidia were trapped, but in 2011, disease onset occurred about 19 days later. Once disease was initiated, the incidence of affected leaves increased sharply. In fruiting fields, disease progressed most rapidly on lower followed by middle and upper leaves and then slowed by mid-July coinciding with a decrease in trapped conidia. In sprout fields, disease progress did not slow until mid-August. These results show that disease begins early in the season deep within the canopy and will require early monitoring of symptoms to effectively time fungicide applications.

Mannitol's possible mode of action against angular leaf spot of strawberry. P.G. BRAUN AND P.D. HILDEBRAND. *Atlantic Food and Horticulture Research Centre, Agriculture and Agri-Food Canada, 32 Main St., Kentville, NS B4N 1J5, Canada*

Bacterial angular leaf spot of strawberry (*Fragariae ×ananassa* Duchesne), caused by *Xanthomonas fragariae* Kenn. & King is a widely distributed disease with few control options. Planting disease free material and application of copper based bactericides have been the primary management strategies but they have had limited success. In a search for new chemical controls we discovered that mannitol, a simple sugar alcohol, provided >90% disease control in controlled environment experiments. It has been reported that mannitol induces disease resistance in tobacco. In strawberry, mannitol provided excellent disease control when applied between 8 days pre-infection and 4 days post-infection. The best control was obtained when mannitol remained on the leaf surface for 24 to 48 hours. These responses to mannitol could be consistent with induced resistance. However, treatment of the center leaflets of trifoliate leaves with mannitol protected only the treated leaflet from infection. Thus the induced resistance does not appear to be systemic. In addition, in liquid shake cultures of *X. fragariae* in the presence of mannitol the exopolysaccharide normally produced is reduced by ~50%. Exopolysaccharide is considered a virulence factor in some pathosystems. RT-PCR analysis of known resistance genes is currently being conducted to provide more specific evidence of induced resistance.

Assessing pathogenicity and chemical sensitivity of *Fusarium spp.* infecting carrots. M.M. MACDONALD, R.D. PETERS, J. DRISCOLL, G. DYKERMAN, S. ADAMS, A. RYAN, C. BANKS, A. MACPHAIL, D. GREGORY AND K.A. DRAKE. *Agriculture and Agri-Food Canada, Crops and Livestock Research Centre, 440 University Ave., Charlottetown, PE C1A 4N6, Canada; (J.D., A.R.) Prince Edward Island Horticultural Association, P.O. Box 2232, Charlottetown, PE C1A 8B9, Canada; (G.D.) Brookfield Gardens, 1067 Millboro Rd., RR#4 North Wiltshire, PE C0A 1Y0, Canada; and (C.B.) Prince Edward Island Department of Agriculture and Forestry, P.O. Box 2000, Charlottetown, PE C1A 7N8, Canada*

Fusarium crown rot, formerly a storage disease of carrots, was present in Prince Edward Island (PEI) fields in 2011 and 2012. Crown lesions on carrots resulted in rejection rates as high as 60-70% during grading for storage in 2011. Infecting organisms were identified as *F. avenaceum* and *F. oxysporum* in samples obtained from field and storage. Research was conducted to assess the pathogenicity and chemical sensitivity of isolates of each species. In a replicated trial, crown tissue was inoculated and carrots incubated for approximately four weeks to rate pathogenicity according to Koch's postulates. Measurements of area and depth of wound indicated that all isolates (10) of *F. avenaceum* were highly pathogenic to carrot tissue. All isolates (4) of *F. oxysporum* were found to be weakly pathogenic in comparison to *F. avenaceum* and treatment controls (uninoculated). Isolates of both species were tested for sensitivity to difenoconazole, fludioxonil, and thiabendazole in an amended agar assay. Chemicals were distributed in six concentrations in an attempt to determine the EC_{50} (the concentration at which the fungal growth is inhibited by 50%) for each isolate. Isolates of *F. avenaceum* had EC_{50} values of >100ppm, 0.1-1.0ppm, and 1-10ppm and isolates of *F. oxysporum* had EC_{50} values of 1-10ppm, >100ppm, and 1-10ppm, for difenoconazole, fludioxonil, and thiabendazole, respectively. *F. oxysporum* was found to be resistant to fludioxonil and sensitive to thiabendazole, whereas *F. avenaceum* was sensitive to both chemicals. However, *F. oxysporum* was sensitive to difenoconazole, whereas *F. avenaceum* was found to be highly resistant. Field studies are underway to develop management options to combat this destructive disease.

Evaluation of seven tomato varieties for field resistance to late blight (*Phytopthora infestans)*. R. COFFIN, J. COFFIN, R. PETERS, K. DRAKE, D. GREGORY, M. MACDONALD, A. MACPHAIL, G. WANG-PRUSKI, B. BEATON, C. BANKS, L. KAWCHUCK, AND A. MELISH. *Privar Farm Inc., 909 Eliot River Road, N. Wiltshire, PE, C0A 1Y0,Canada; (R. P., K. D., D.G., M.M., A.M) Agriculture and Agri-Food Canada, 440 University Ave., Charlottetown, PE C1A 4N6, Canada; (G. W-P)Faculty of Agriculture, Dalhousie Univ.,50 Pictou Road, Truro, NS B2N 5E3, Canada; (B.B., C. B.) PEI Dept. of Agr., University Ave, Charlottetown, PE C1A 7N3, Canada; (L. K.) AAFC, Lethbridge, AB T1J 4B1;and (A. M.) Veseys Seeds Ltd. York, PE C0A 1P0, Canada*

Gardeners often encounter fruit rot in tomatoes as they have limited access to fungicides or resistant varieties. A breeding project in North Carolina has released new varieties (Mountain Magic, Defiant, Plum Regal) with resistance to late blight. Field plots were established on Prince Edward Island in 2012 to assess resistance to late blight in these three resistant varieties in comparison to four susceptible varieties (Scotia, Brandywine, Oxheart and Monster). Two blocks were planted with 7 varieties; one block sprayed weekly with the fungicide chlorothalonil rotated with manzate. The check block did not receive fungicides. Extensive development of late blight, initiated by naturally-occurring inoculum, occurred in both foliage and fruit of the four susceptible varieties, in the unsprayed check block, compared to very limited disease development in the varieties Mountain Magic and Defiant (highly resistant, but not immune) and moderate infection in Plum Regal. Tomato plants managed with fungicides were free of disease. Sweet pepper plants (variety, New Ace), included in both blocks, did not develop any symptoms of late blight in foliage or fruit. Volunteer potato plants near the tomato trial were found to be infected with the late blight pathogen. Isolation of *P. infestans* from the infected potato and potato tissues and subsequent analysis of allozymes at the glucose phosphate isomerise (GPI) locus via cellulose acetate electrophoresis provided a preliminary identification of pathogen strain (US 23).The US-23 genotype of *P. Infestans* has migrated from western to eastern Canada in recent years and colonizes potatoes and tomatoes in Atlantic Canada.

Assessment of in-furrow application of Vertisan ™ (penthiopyrad) fungicide for control of *Rhizoctonia* (black scurf) and common scab in three varieties of potatoes

R. COFFIN, J. COFFIN, R. PETERS, K. DRAKE, B. BEATON AND B. FRASER. *Privar Farm Inc. 909 Eliot River road, N. Wiltshire, PE C0A1Y0, Canada; (R.P., K.D.) Agriculture and Agri-Food Canada, 440 University Ave., Charlottetown, PE C1A 4N6, Canada; (B.B.) PEI Dept.of Agr., University Ave., Charlottetown, PE C1A 7N3, Canada; (B.F.) Dupont Canada Company, Mississauga, ON L5M 2H3, Canada*

Potato disease symptoms on potato skin can render tubers unmarketable for fancy tablestock markets and seed use. Vertisan ™ was applied in-furrow, over seed pieces at planting, at the rate of 30 ml of product per 100 meters of row in a band width of approximately 25 cm. Three potato varieties (Yukon Gold, Arbor Globe, Hot Pink) were planted in the treated and non-treated blocks. Previous crops of potatoes in this land had extensive development of black scurf and common scab. Six tubers per plant were harvested from four plants in each variety from the treated and non-treated soil. Tuber samples were coded and rated without bias by six evaluators. Common scab was prevalent (10-15 % of skin surface) on the three potato varieties and the extent of development was unaffected by the treatment. Daughter tubers from plants of all three potato varieties, in the Vertisan ™ treated rows, did not show any *Rhizoctonia* symptoms (black scurf stage). In non- treated samples, *Rhizoctonia* was most prevalent on the variety Yukon Gold, low in Hot Pink and non-detectable in Arbour Globe. The Vertisan ™ treatment suppressed the development of black scurf and improved acceptability of potato tubers to meet requirements for fancy tablestock and seed potatoes.

Discovery of resistance to metalaxyl-m in populations of *Phytophthora erythroseptica* causing pink rot of potato in Prince Edward Island. R.D. PETERS, B.W. BEATON, M.M. CLARK, B. FORRESTER, A. MACPHAIL, K.A. DRAKE, D. GREGORY AND M.M. MACDONALD. *Agriculture and Agri-Food Canada, Crops and Livestock Research Centre, 440 University Ave., Charlottetown, PE C1A 4N6, Canada; (B.W.B., M.M.C.) Prince Edward Island Department of Agriculture and Forestry, P.O. Box 2000, Charlottetown, PE C1A 7N8, Canada; and (B.F.) Cavendish Agri Services, 4504 Alleys Mills Rd., Pooles Corner, PE C0A 1G0, Canada*

After a hot, dry summer, autumn rains delayed harvest and contributed to incidences of potato tuber rot in several regions of Prince Edward Island (PEI) in 2012. Disease diagnosis indicated that pink rot, caused by *Phytophthora erythroseptica*, was prevalent in many affected fields. A collection of tubers sampled from 12 individual fields from various production regions in PEI yielded 59 isolates of *P. erythroseptica*. These isolates were tested for their sensitivity to metalaxyl-m in amended agar assays. All isolates (22 isolates) from 3 fields in eastern PEI were found to be highly resistant to metalaxyl-m, whereas isolates (37 isolates) from 9 fields in central portions of the province were found to be metalaxyl-sensitive. This is the first report of metalaxyl-m resistance in populations of *P. erythroseptica* in PEI. Previously, isolates of the pathogen with resistance to metalaxyl-m had been recovered from surrounding potato production areas in New Brunswick and Maine, USA. The discovery of metalaxyl-m resistance raises concerns about the efficacy of applications of Ridomil Gold ® for pink rot control and may add importance to the role played by phosphites in the management of this disease.

Phosphite for late blight control in potato production – Update of the CHC project. G. WANG-PRUSKI, R. COFFIN, R. PETERS, Z. GANGA, K. AL-MUGHRABI, B. PRITHIVIRAJ, AND D. PINTO. *Department of Plant and Animal Sciences, Faculty of Agriculture, Dalhousie University, Truro, NS B2N 5E3, Canada; (R.C.) Privar Farm Inc., 909 Eliot River Road North Wiltshire, PE C0A 1Y0, Canada; (R.P.) Agriculture and Agri-Food Canada, Charlottetown, PE C1A 4N6, Canada; (Z. G.) Cavendish Farms, New Annan, PE C1N 4J9 Canada; (K. A.) New Brunswick Department of Agriculture, Aquaculture and Fisheries; Wicklow, NB E7L 3S4, Canada; (D.P.) National Research Council Institute for Marine Biosciences, Halifax, NS B3H 3Z1, Canada*

The CHC Agri-Science Cluster for Horticulture was initiated in 2010. We participated in this three-year program, focused on studying the function of phosphorous acid related compounds on suppression of late blight in potatoes. The program is aimed at four major objectives: 1) study of phosphorous acid –response proteins for their functions against late blight in foliage and tubers; 2) study on effects of phosphorous acid on disease development on foliage and tubers; 3) examination of translocation of phosphorous acid in potato plants and tubers and subsequent functions against pink rot and other tuber diseases; and 4) determination of effective use of phosphorous acid in potato production systems. To date, significant data from proteomic profiling, gene expression, field and greenhouse evaluations, translocation and residue analyses, and the behaviour of the pathogen, have been obtained. We now have a better understanding of the molecular mechanisms of induced resistance by phosphite and we are able to provide its better usage to manage late blight for potato production.

How fast, how many and for how long: deciphering the defense mechanisms induced by phosphite-based fungicides in potatoes. T. BORZA, Y. WANG, AND G. WANG-PRUSKI. *Department of Plant and Animal Sciences, Dalhousie University, Faculty of Agriculture, 50 Pictou Road, Truro, NS B2N 5E3, Canada*

Fungicides containing phosphorous acid derived salts (phosphites – Phi) are increasingly used in controlling the development of the oomycete *Phytophthora infestans* (Mont.) de Bary, which is responsible for the occurrence of late blight disease in potatoes. The fungistatic effects of Phi are exerted directly by inhibiting pathogen's development and indirectly by inducing plant defense mechanisms. The way Phi induces resistance in plants is still largely unknown. With the aim to determine the effects of Phi on the potato plant's signaling pathways and on defense mechanisms that are likely to be responsible for induced resistance against *P. infestans* we analyzed, using quantitative RT-PCR, the expression pattern of several genes involved in the salicylate (SA), jasmonic (JA) and ethylene (ET) signaling pathways before and after treatment with the Phi-based fungicide Confine™ (Winfield Solutions, LLC, St. Paul, MN). The results indicate that Phi induces rapid activation (30 min. to 24 h) of positive transcriptional regulators in the SA pathways. ET seems to work in conjunction with SA to transiently silence (2 h to 48 h) the expression of genes involved in the JA signalling pathway. Notably, SA-related expression pattern overlaps with the Phi translocation pattern determined by ion chromatography. Limited responses have been detected in Phi-treated and untreated plants infected with *P. infestans*. The finding that Phi triggers fast but short lasting activation of the SA signalling pathway and of other defense mechanisms suggests new ways for improving field practices such as the timing of Phi application in order to achieve maximum crop protection.

Phosphites affect mycelial growth and induce morphological changes in *Phytophthora infestans*. X. GAO, G. SAKTHIVEL, T. BORZA, Y. WU, AND G. WANG-PRUSKI. *Faculty of Agriculture, Dalhousie University, Truro, NS B2N 5E3, Canada*

Phosphite-based fungicides are increasingly used in controlling late blight development in potato crops. However, the effectiveness of various formulations of phosphites in limiting the development of *Phytophthora infestans* (Mont.) de Bary, is still unclear. This study investigated the effects of two different phosphite fungicides (Confine™ and Phostrol™) on the growth and morphology of *P. infestans* A2 genotype US8 strain *in vitro*. Mycelium growth and sporangia production were estimated by culturing the pathogen on pea agar medium supplemented with different concentrations of Confine™ and Phostrol™ (0.01% to 0.3% phosphites), followed by measuring the diameter of colonies at 7 and 14 days post-inoculation, and counting sporangia at 14 days post-inoculation. To investigate whether phosphites induce morphological changes in *P. infestans*, the pathogen was cultivated in pea broth for 7 days at 18°C, and then in soil-water extract containing different concentrations of Confine™ and Phostrol™ (0.005 to 0.1% phosphites) for 3 more days at 18°C. Morphological changes of mycelia and sporangia were observed using an inverted microscope. Our results indicated that both fungicides showed very strong inhibition on *P. infestans* mycelia growth, with an IC_{50} of around 0.007% (920 µM) phosphites. Sporangia production was strongly inhibited by 0.05% Confine™ and 0.1% Phostrol™. Concentrations of 0.1% Confine™ and 0.3% Phostrol™ completely inhibited the growth and sporangia production. Both Confine™ and Phostrol™ in the concentration range of 0.05% to 0.1% caused morphological changes of hyphae and sporangia in *P. infestans*. Swollen, tip end lysis and short-branched hyphae and distorted, abnormal-shaped, and elongated sporangia were observed.

Notes

Notes

Directions to The Port Pub and Bistro, Port Williams
Leaving the Research Centre, turn RIGHT onto #1. As you drive on #1 through New Minas, you will encounter a number of stop lights. At the fifth stop light that you encounter (Greenwich, about 6 km from AFHRC), turn LEFT onto #358. Continue over the Cornwallis River bridge and take the first RIGHT onto Kars St. The Port Pub is directly ahead on the corner (980 Terrys Creek Rd).