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Proceedings of the 33rd Annual Meeting of the Plant Pathology Society of Alberta

November 5–7, 2012
Wayside Inn, Lloydminster, AB

Sponsorship Provided By:

Schedule of Events – 33rd Annual Meeting

November 5–7, 2011 Wayside Inn, Lloydminster, AB

Date & Time	Event
Monday, Nov. 5	
12:00 pm – 6:00 pm	Disease ID workshop, Lakeland College
6:30 pm – 8:00 pm	Registration and poster set-up
7:30pm – 9:00pm	Reception and informal poster viewing
Tuesday, Nov. 6	
8:00am – 9:30 am	Registration
8:30 am – 9:30 am	PPSA Business meeting
9:30 am– 10:00 am	Refreshment break
10:00 am – 10:10 am	Welcome and opening remarks
10:10 am – 12:00 am	Paper session I (Moderator, M. Leggett)
10:15 am – 11:15 am	Keynote address: G.C. Bergstrom, Cornell University
12:00 pm – 1:30 pm	Lunch
1:30 pm – 3:00 pm	Paper session 2 (Moderator B.D. Gossen)
2:10 pm – 2:40 pm	Invited presentation: M.R. McDonald, Univ. of Guelph
3:00 pm – 3:30 pm	Refreshment break
3:30 pm – 4:45 pm	Poster session
6:30 pm – 9:00 pm	Banquet
Wednesday, Nov. 7	
8:00 am – 8:30 am	Breakfast
8:30am – 11:00am	Paper session 3 (Moderator C. Franke)
8:30am – 9:00am	Invited presentation: B.G. Gossen, AAFC, Saskatoon
Adjournment	

33rd Annual Meeting of the Plant Pathology Society of Alberta

Abstracts

Oral Presentations:

Evaluation of promising bacterial strains for biological control of post-harvest and storage decay pathogens on fruits and vegetables. S.M. BOYETCHKO, T. ZHOU, P. AUDY AND A.M. SVIRCEV. *Saskatoon Research Centre, Agriculture and Agri-Food Canada (AAFC), 107 Science Place, Saskatoon, SK S7N 0X2; (T.Z.) Guelph Food Research Centre, AAFC, 93 Stone Road W., Guelph, Ontario N1G 5C9; (P.A.) Soils and Crops Research and Development Centre, AAFC, 2560, boul. Hochelaga, Québec, Québec G1V 2J3; (A.M.S.) Southern Crop Protection and Food Research Centre, AAFC, 4902 Victoria Ave N, PO Box 6000, Vineland Station, ON L0R 2E0*

The value of post-harvest losses caused by diseases and pests in fruits and vegetables is over $300 billion each year worldwide. Important storage pathogens include *Monilinia fructicola,* (Winter) Honey, *Botrytis cinerea* (Persoon) Fries, *Sclerotinia sclerotiorum* (Libert) de Bary and *Phytophthora infestans* (Mont.) de Bary. The principal management strategy for these diseases is application of chemical fungicides, but issues related to health and safety, pesticide residues in food and fungicide resistance are a major concern. Several bacterial isolates belonging to *Bacillus* spp., *Pseudomonas* spp., and *Pantoea* spp. were selected for evaluation as possible biological control candidates against these pathogens. These bacteria were tested for their ability to inhibit spore germination and mycelial growth, and to reduce infection on fruits and tubers of peach, tomato, and potato. Nine of the bacterial isolates inhibited conidial germination of *M. fructicola* and 10 of the isolates inhibited mycelial growth. Pre- and post-harvest application of *Bacillus amyloliquefaciens* BM01 reduced the incidence of brown rot by over 80%. More than 50 bacterial isolates belonging to *Bacillus* and *Pseudomonas* significantly reduced mycelial growth of *P. infestans*, while 8 to 10 bacterial isolates reduced spore germination, mycelial growth, and sclerotial formation of *S. sclerotiorum* and *B. cinerea*. In some cases, inhibition of fungal growth was 100%. The mode of action for the biocontrol activity by the bacteria, including the role of extracellular antimicrobial substance(s) and induced resistance is being explored.

Characterization and management of *Fusarium* species from Alberta potato storages. G.C. DANIELS, L.M. KAWCHUK, M.J. UNRUH, M.W. HARDING, AND R.J. HOWARD**.** *Innovotech Inc. 301 Horticultural Station Rd. E., Brooks, AB T1R 1E6 Canada; (LMK) Agriculture & Agri-Food Canada, Lethbridge Research Station, 5403 - 1 Avenue South PO Box 3000, Lethbridge, AB, T1J 4B1, Canada; (MWH, RJH) Alberta Agriculture and Rural Development, Crop Diversification Centre South, 301 Horticultural Station Rd. E., Brooks, AB T1R 1E6 Canada.*

A study began in 2010 to evaluate the incidence, severity and economic impact of *Fusarium spp.* infections in commercial potatoes in Alberta. The objectives were to: 1) identify *Fusarium* species from Alberta fields and storages, 2) rate the relative sensitivity of isolates to current fungicides, and 3) look for natural tolerance or partial resistance to Fusarium dry rot in available cultivars and elite lines. Fifty two isolates were collected in 2010 and 92 isolates in 2011. Isolates were cultured from tubers collected from commercial storages and retail outlets. In 2010, the predominant species isolated was *F. coeruleum* (44.2%) followed by *F. sambucinum* (42.3%) and *F. avenaceum* (3.8%). This changed in 2011 when the predominant species was *F. sambucinum* (63%) followed by *F. avenaceum* (20.6%), *F. coeruleum* (11.9%) and *F. culmorum* (3.3%). Single-spore isolates from the 2011 cultures were evaluated for sensitivity to fludioxonil and thiophanate-methyl fungicides. Eighteen isolates (19.5%) were resistant to thiophanate-methyl, twelve (13.0%) were resistant to fludioxonil and seven (7.6%) were resistant to both. In addition, the reactions of 10 potato varieties to *F. sambucinum* were evaluated by inoculating wounded tubers and placing them in storage. A range of responses to *F. sambucinum* was observed with some varieties being much more tolerant to infection and others highly susceptible.

Alternative strategies for controlling Sclerotinia white mold in dry edible bean. M.W. HARDING, R.D. DANIELS, M.J. UNRUH AND A. ELHADRAMI**.** *Alberta Agriculture and Rural Development, Crop Diversification Centre South, 301 Horticultural Station Rd. E., Brooks, AB T1R 1E6 Canada; (RDD, MJU). Innovotech Inc. Suite 101 - 2011 94 St., Edmonton, AB T6N 1H1 Canada; (AE) OMEX Agriculture Inc., P.O. Box 301, 290 Agri Park Road, Oak Bluff, MB, R0G 1N0, Canada.*

White mold on dry bean, caused by *Sclerotinia sclerotiorum* (Lib.) de Bary is a major production problem for bean producers in Canada. In 2011, alternative methods for improving white mold control in dry beans were tested, namely using micronutrient fertilizers and a plant defense activator. Treatments were applied to seed prior to planting, or as foliar treatments at flowering. The results in 2011 clearly indicated that white mold control with the fungicide boscalid could be improved by more than 60% when tank mixing the micronutrient manganese with the fungicide. Additionally, the plant defense activator reduced white mold by more than 70%, compared to the check plots, when applied as a seed treatment. The same trials were repeated in 2012, with the addition of other foliar applied micronutrients. Similar results were obtained that demonstrated the ability of certain micronutrients to act synergistically with boscalid to improve white mold control on dry bean. Manganese or zinc improved boscalid performance by 18% and copper improved the performance by 163%. Additionally, the plant defense activator, applied as a seed treatment, significantly reduced white mold disease incidence when compared with the check plots.

Infection and gene expression profiles of primary and secondary zoospores of *Plasmodiophora brassicae*. J. FENG, S. F. HWANG AND S. E. STRELKOV. *Crop Diversification Centre North, Alberta Agriculture and Rural Development, Edmonton, AB T5Y 6H3, Canada; and (S.E.S.) Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, AB T6G 2P5, Canada.*

The early stages of infection of canola roots by *Plasmodiophora brassicae* were investigated. Inoculation with secondary zoospores produced primary infections similar to those produced by resting spores. When the plants were inoculated with 1×10^7 resting spores/ml two days after being challenged with 1×10^4 or 1×10^5 resting spores/ml, secondary infections were observed earlier than the secondary infections after inoculation with the 1×10^7 resting spores/ml suspension alone, and more severe than those produced by the 1×10^4 or 1×10^5 resting spores/ml suspensions alone. Compared to the single inoculations, secondary infections on plants that had received both inoculations remained at higher levels throughout a 7-day time course. These data indicate that primary zoospores can cause secondary infection directly when the host is under primary infection. To differentiate primary and secondary zoospores on the gene expression level, 118 *P. brassicae* genes, representing all database-available proteins and ESTs, were investigated for their expression in the two spore types by dot-blot hybridizations and real-time PCR analyses. Both approaches identified up- and down-regulated genes and the correlation between them was confirmed. Real-time PCR indicated that 58 genes were up-regulated in secondary zoospores relative to primary zoospores, whereas 55 were down-regulated. These data suggest that different mechanisms are utilized by the pathogen in causing of primary and secondary infections.

A comparison of clubroot (*Plasmodiophora brassica* Woronin) development and management on Brassica vegetables and canola. B.D. GOSSEN, M.R. McDONALD, S.F. HWANG, S.E. STRELKOV, AND G. PENG. *Agriculture and Agri-Food Canada, Saskatoon, SK, S7N 0X2, Canada, (M.R.M.) University of Guelph, Guelph, ON N1G 2W1, Canada, (S.F.H.) Alberta Agriculture and Rural Development, Edmonton, AB T5Y 6H3, Canada, and University of Alberta, Edmonton, AB T6G 2P5, Canada.*

Clubroot of canola (*Brassica napus* L.) was identified near Edmonton AB in 2003 and is spreading rapidly across the prairie region. Although clubroot has been studied extensively on vegetable Brassicas, it was not clear initially how much of the knowledge would be directly transferable from the intensive vegetable production to canola. The objective is to examine the similarities and differences between clubroot on vegetable crops and canola. One important difference was the rapid spread of clubroot in canola within and between fields. Also, clubroot generally has a larger economic impact on canola (harvested for seed) than on vegetables (vegetative). Resistance to clubroot is the most effective approach to clubroot management in canola, but several lines of evidence from recent work indicate that resistance may not be durable. Fortunately, the large acreage of canola ensures that the industry will develop new sources of resistance as existing sources of resistance are eroded. Crop rotation appears to have a strong impact on canola. Pathogen development and cultural control are very similar on vegetables and canola; bait crops and soil amendments are not commercially viable in either system; and biocontrol has a limited potential at this time. Manipulation of seeding date and application of fungicide(s) have more potential for use on vegetables than for canola. Identification of strategies that reduce inoculum pressure in clubroot-infested fields and increase the durability of genes for clubroot resistance represent important lines of future research.

Screening for all-stage resistance to *Puccinia striiformis* f. sp. *tritici* and f. sp. *hordei* in western Canadian wheat, triticale, and barley cultivars. M.D. HOLTZ, K. KUMAR, AND K. XI. *Field Crop Development Centre, Alberta Agriculture and Rural Development, 6000 C and E Trail, Lacombe, AB. Canada T4L 1W1.*
Stripe rust of wheat, *Puccinia striiformis* Westend. f. sp. *tritici* Eriks. & Henn., (*Pst*) has recently become an important pathogen of wheat in western Canada. Stripe rust of barley, *P. striiformis* f. sp. *hordei* Eriks. & Henn., (*Psh*) has been observed frequently in Alberta. The objective of this study was to determine if there are effective all-stage (seedling) resistance genes in western Canadian wheat, triticale, and barley cultivars. The reactions of 64 wheat, ten triticale, and 47 barley cultivars to a variety of *Pst* and *Psh* isolates, representative of the pathogen population found in Alberta, was determined. There were few detectable all-stage resistances in wheat or triticale to *Pst*, with no cultivars being resistant to all isolates. The majority of Canada Western Red Spring, Canada Western Extra Strong, Canada Western Red Winter Select, and Canada Western Red Winter Generic wheat were susceptible to *Psh*, particularly members of a group of isolates believed to be the result of hybridization between *Psh* and *Pst*. The vast majority of barley cultivars were susceptible to all *Psh* isolates and no cultivar possessed resistance to all *Psh* isolates. Most 2-row barley cultivars were resistant to all *Pst* isolates whereas the majority of 6-row barleys were susceptible to multiple *Pst* isolates.

Managing stripe rust of wheat with fungicides and resistant cultivars. H.R. KUTCHER, J. WOYTOWICH, J. TAYLOR, AND T. DAMENT. *Crop Development Centre, University of Saskatchewan, 51 Campus Drive, Saskatoon, SK S7N 5A8, Canada*
Stripe rust of wheat, caused by *Puccinia striiformis* Westend. f. sp. *tritici* Eriks. & Henn., was the cause of substantial yield and quality losses in wheat across much of western Canada in 2011. Some previously resistant wheat cultivars are dependent on seedling resistance genes, which are no longer effective against current *P. striiformis* races. The objective of this study is to determine the benefit of fungicide and cultivars carrying adult plant resistance (APR) genes as stripe rust mitigation strategies. Two split-plot experiments, one seeded May 21st and the other June 4th, were established at Saskatoon, SK. Main plots consisted of fungicide (tebuconazole) applied once at each of three crop growth stages (stem elongation, 50% anthesis and early milk; 4.5, 11.51 and 10.54 Feekes scale, respectively), plus one treatment that received 3 applications of fungicide at each of the 3 growth stages, and a fifth treatment consisting of an unsprayed check. Sub-plots were three cultivars: AC Barrie (susceptible), CDC Imagine (one APR gene, *Yr18*) and Lillian (two APRs, *Yr18* and *Yr36*). Stripe rust severity (percentage of flag leaf affected) for the May 21st seeding date was 41% on AC Barrie (unsprayed) compared to 7% for the June 4th seeding date. At both seeding dates, stripe rust symptoms on AC Barrie were greatly reduced by fungicide application at 50% anthesis. The trend was similar, although not as dramatic for CDC Imagine; however, Lillian did not respond to fungicide in terms of stripe rust symptoms because stripe rust severity was very low. Overall, yield was somewhat greater for the June 4th seeding date than for the May 21st seeding date. Despite reduced stripe rust severity as a result of fungicide application, yield increases of AC Barrie and CDC Imagine were limited. No response to fungicide was observed for Lillian. Surprisingly, for the May 21st seeding date, yield of the stripe rust susceptible cultivar, AC Barrie was greater than either CDC Imagine or

Lillian, regardless of the timing of fungicide application. This result was not observed in the June 4th seeding date, where yield of AC Barrie and CDC Imagine were similar and both were greater than yield of Lillian. These preliminary results suggest that response to fungicide may vary with cultivar, particularly cultivars that differ in resistance to stripe rust, seeding date and time of fungicide application. Further experimentation will be conducted to establish these relationships.

Reaction of western Canadian spring wheat cultivars to infection with *Claviceps purpurea.* L. MALO AND P. HUCL. *Department of Plant Sciences/Crop Development Centre, University of Saskatchewan, College of Agriculture and Bioresources, 51 Campus Drive, Saskatoon, SK S7N 5A8, Canada.*
Ergot, caused by the fungal pathogen *Claviceps purpurea*, has re-emerged in recent years as a threat to the Canadian wheat industry. The pathogen attacks the floral organs of many cereal species resulting in the production of sclerotia instead of wheat kernels. Infection results in reduced yields, downgrading, and poisoning if consumed by humans or animals. Few studies have been conducted on ergot in wheat, and there are no control measures other than prevention. The first objective of this study was to determine if Western Canadian spring wheat cultivars differ in susceptibility to ergot under both field and controlled conditions. The second objective was to determine if infection level is influenced by inoculum level under field conditions. Differences in disease reaction were measured by the frequency and percentage by weight of sclerotia in the seed sample harvested from each plot, and for the controlled environment component, data collection also included the amount of honeydew produced and the size of the sclerotia size. Preliminary results suggest that there are differences in disease reaction among the cultivars and classes, but not among inoculum levels.

Advances in control methods based on canopy modifications to manage plant diseases. M.R. McDONALD[1], B.D. GOSSEN[2], C. KORA[3], M. PARKER[1] AND G.J. BOLAND[4]. *[1]Dept. of Plant Agriculture, Univ. of Guelph, Guelph, ON, N1G 2W1, Canada. [2]Agriculture and Agri-Food Canada, Saskatoon, SK, S7N OX2, Canada. [3]Agriculture and Agri-Food Canada, Ottawa, ON, Canada. [4]School of Environmental Sciences, Univ. of Guelph, Guelph, ON N1G 2W1, Canada.*
There are several examples where modifying the plant canopy has been used to successfully manage plant diseases in vegetable and field crops. Recent research has established that trimming the carrot canopy can suppress sclerotinia rot of carrot (SRC, caused by *Sclerotinia sclerotiorum).* Lateral trimming of the canopy by 30- 40% just after the crop canopy closes can effectively reduce SRC to zero under moderate disease pressure, with no decrease in yield. Trimming reduces relative humidity, and increases air and soil temperature, within the carrot canopy, which inhibits the formation of apothecia on the sclerotia of *S. sclerotiorum* (1). Trimming also severs infected petioles, preventing the progression of infection to the carrot crown. When trimming was combined with applications of a fungicide (boscalid) or biofungicide (chitosan), trimming alone reduced SRC, but the combination of trimming and sprays was even more effective. Trimming also reduced carrot leaf blights (caused by *Alternaria dauci* and *Cercospora carotae)* in one of three years when disease pressure was low. There was no

advantage of combining trimming and fungicide sprays for leaf blight control (2). Canopy modification also plays a role in disease suppression in legume crops. In soybean, selection of varieties with reduced height, lodging and/or maturity resulted in up to a 74% reduction in apothecia of *S. sclerotiorum*, and up to an 88% reduction in incidence of white mold at harvest. As with carrots, this strategy is associated with reduced relative humidity and soil moisture within the crop, and has been a recommended practice in some areas for more than 20 years. Over the last 20 years, the field pea (*Pisum sativum*) crop in western Canada has switched from fully-leaved cultivars to leafless and semi-leafless cultivars. The result is reduced lodging and a more open canopy, which allows more air movement. This reduces the severity of foliar disease caused by *Mycosphaerella pinodes* (3) and others. Similarly in chickpea (*Cicer arietinum*), opening up the canopy using variations in seed row spacing increased deposition of fungicides within the canopy, reducing both the severity of ascochyta blight (*Ascochyta rabiei*) and the number of fungicide applications required to manage this important disease. In conclusion, there are a number of different crops where canopy modification can be used to manage diseases without the use of additional fungicides, or where this approach sometimes improves the efficacy of crop protection materials.

1) Kora, C., M.R. McDonald and G. J. Boland. 2005. Plant Dis. 89: 549-557. 2) McDonald, M.R., Vander Kooi, K.D. and Westerveld, S.M. 2008. Plant Dis. 92:132-136. 3) Wang, T.F., Gossen, B.D., and Slinkard, A.E. 2006. Can. J. Plant Sci. 86: 855–863.

Recent occurrence of blackleg on canola and the profile of *Leptosphaeria maculans* races on the Canadian prairies. G. PENG, W.G.D., FERNANDO, H.R. KUTCHER, D.J. CROSS, S.H. LIBAN, F.Q. YU, C. KIRKHAM, F.L. DOKKEN-BOUCHARD, D. MCLAREN AND A. KUBINEC. *(G.P., F.Q.Y.) Agriculture and Agri-Food Canada (AAFC), Saskatoon Research Centre, 107 Science Place, Saskatoon, SK S7N 0X2, Canada; (W.G.D.F., S.H.L.) Department of Plant Science, University of Manitoba, 66 Dafoe Road, Winnipeg, MB R3T 2N2, Canada; (H.R.K.) Department of Plant Sciences, University of Saskatchewan, 51 Campus Drive, Saskatoon, SK S7N 5A8, Canada; (D.J.C., C.K.) AAFC Melfort, SK S0E 1A0, Canada; (F.L.D.) Saskatchewan Ministry of Agriculture, 3085 Albert Street, Regina, SK, S4S 0B1, Canada; (D.M.) AAFC Brandon Research Centre, 18th Street North and Grand Valley Road, Brandon, MB R7A 5Y3, Canada; (A.K.) Manitoba Agriculture, Food & Rural Initiatives, 65-3rd Avenue NE, Carman, MB R0G 0J0, Canada.*

Blackleg disease of canola (*Brassica napus* L.), caused by *Leptosphaeria maculans* (Desmaz.) Ces. & De Not., has been on the rise in many parts of the Canadian prairies recently, especially in Manitoba and Alberta where a substantial number of fields were found with >30% disease incidence during 2010 and 2011 Canola Disease Surveys. In 2012, a significant number of fields with R- or MR-rated canola cultivars were severely diseased. Almost all these fields had a short crop rotation or continuous canola. Varietal resistance plus 3- to 4-year crop rotation are the key strategy for blackleg management. For optimal results, selection of canola cultivars with specific resistance genes should be based on a good understanding of pathogen race structure in a region. An extensive study of *L. maculans* isolates collected in 2007, base on the infection on a set of Brassica lines with the known resistance genes *Rlm1-4*, *Rlm6*, *Rlm7*, *Rlm9*, and *LepR1,3*, showed that only the avirulence (*Avr*) alleles *AvrRlm2*, *AvrRlm4*, *AvrRlm5*, and *AvrLepR3* were present

in >50% of the isolates, while the other *Avr* alleles were at relatively lower frequencies. The lack of, or very low frequency of these *Avr* genes in the pathogen population indicated that canola cultivars with the resistance genes corresponding to those absent or low-frequency *Avr* alleles would likely be ineffective against blackleg. More recent analysis of *L. maculans* race structure based on samples from commercial fields in Manitoba and Saskatchewan in 2010 showed that *AvrLm1,3,9* and *AvrLepR1,2* were even at lower frequencies (0-8%) than before, indicating that the resistance genes *Rlm1, Rlm3, Rlm9, LepR1* and *LepR2* are ineffective against blackleg in either province. The resistance genes *Rlm2, Rlm4, Rlm5/6, Rlm7,* and *LepR3,* however, are still of some value. This information may be used to recommend appropriate resistant cultivars to canola growers and for selection of effective resistance genes to be used in breeding new blackleg-resistant canola cultivars.

Management of clubroot disease on canola with crop rotation combined with host resistance or biofungicide seed dressing. G. PENG, D. PAGEAU, S.E. STRELKOV, R. LAHLALI, B.D. GOSSEN, K. ANDERSON, S.F. HWANG, M.R. McDONALD, F.Q. YU, K.C. FALK, T. K. TURKINGTON, R.K. HYNES, S.M. BOYETCHKO, AND L. MCGREGOR. *Saskatoon Research Centre, Agriculture and Agri-Food Canada* (*AAFC*), *107 Science Place, Saskatoon, SK; (D.P.) AAFC Research Farm, 1468, Saint-Cyrille St., Normandin, QC; (S.E.S.) Dept. Agricultural, Food and Nutritional Science, Univ. of Alberta, Edmonton, AB; (K.A.) Bayer CropScience, 295 Henderson Drive, Regina, SK; (S.F.H.) Crop Diversification Centre North, Alberta Agriculture and Rural Development, 17507 Fort Road, Edmonton, AB; (M.R.M) Dept. Plant Agriculture, Univ. of Guelph, Guelph, ON; and (T.K.T) AAFC Lacombe Research Centre, 6000 C & E Trail, Lacombe, AB, Canada.*
Field studies were conducted in 2011 and 2012 to assess the effect of crop rotation, in combination with biofungicide seed dressing or cultivar resistance, on clubroot (*Plasmodiophora brassicae* Woronin) of canola (*Brassica napus* L.) in a heavily infested field at Normandin, QC. In the first study, seed of a susceptible (S) cultivar was treated with a *Bacillus subtilis* formulation and sown in plots with a 1-, 3- or 11-year break from the previous canola crop. The *B. subtilis* seed dressing did not reduce clubroot severity, but a 3- or 11-yr break from canola showed substantially better crop development and increased yield relative to a 1-yr break. The longer crop rotation reduced *P. brassicae* inoculum in the soil, based on bioassay and quantitative PCR assessment. In a second study, canola cultivars resistant (R), moderately susceptible (MS), and susceptible to clubroot were seeded in plots with a 0, 1-, 2-, 3- or 4-yr break from canola. A 3- or 4-yr break showed lower impact of clubroot on S and MS cultivars relative to a 0 to 2-yr break where the plants were largely killed before maturity. With longer crop rotations, most of the MS plants survived and produced a crop that was noticeably better than the S cultivar but still poorer than the R cultivar. We conclude that a 3- to 4-yr break from canola will reduce the impact of clubroot on canola. However, this measure alone will likely not be enough to permit the use of S or MS cultivars in heavily infected fields, so an R cultivar is still required for the maximum yield potential.

Genetic variation of *Wheat streak mosaic virus* in the United States Pacific Northwest
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The causal agent of wheat streak mosaic; *Wheat streak mosaic virus* (WSMV), is the type member of the genus *Tritimovirus*. It is found throughout the world in wheat growing regions; in the mid-western United States the pathogen is known to cause severe yield loss. WSMV is typically not a serious pathogen in the United States Pacific Northwest. However, it could negatively affect the establishment of perennial wheat currently being considered as a method to prevent soil erosion in the region. Between 2008 and 2010, 50 isolates of WSMV were collected from wheat growing regions of south eastern Washington and north eastern Idaho to estimate the amount of genetic variation present in the population. Coat protein sequence data collected from each isolate and used in phylogenetic analysis of population dynamics supported the identification of two clades of WSMV. Isolates in Clade I share sequence similarity to previously characterized isolates from Central Europe while isolates in Clade II shared similarity to those from Argentina, Australia and the United States Pacific Northwest. The diversity found in this study could increase the difficulty in breeding for durable resistance in perennial wheat if the resistance genes currently used exhibit a differential response to isolates of WSMV from differing clades.

Mapping and cloning of clubroot resistance genes in *Brassica* species. F. YU, G. PENG, K. FALK, M. CHU, X. LIU, X. ZHANG AND A. CHANG. *Saskatoon Research Centre, Agriculture and Agri-Food Canada (AAFC), 107 Science Place, Saskatoon, SK S7N 0X2, Canada*
Clubroot, caused by *Plasmodiophora brassicae* Woronin, poses a serious threat to canola production in western Canada. Genetic resistance is considered to be the most efficient method for disease control. In amphidiploid *Brassica* species, sources of resistance are very limited in canola (*B. napus* L.) and no resistance is available in *B. juncea* and *B. carinata*. At the AAFC-Saskatoon Research Centre, eight accessions originating from vegetable types of *B. rapa* and *B. oleracea*, and from *B. nigra* (black mustard), were found to have a high level of resistance to all pathotypes (2, 3, 5, 6 and 8) of *P. brassicae* identified in Canada to date. Mapping of clubroot resistance genes was carried out in two *B. rapa* lines (FN and JNC) and in one *B. nigra* line (PI). DNA samples were analyzed with microsatellite markers. Two resistance genes from the *B. rapa* lines FN and JNC, herein designated *Rpb1* and *Rpb2*, respectively, were mapped to different genomic regions on *B. rapa* linkage group A3. A third clubroot resistance gene, namely *Rpb3*, was mapped to *B. nigra* linkage group B5. Candidate genes of *Rpb1* and *Rpb2*, which encode toll interleukin 1 receptor (TIR) - nucleotide binding site (NBS) - leucine-rich repeat (LRR) proteins, have been isolated from FN and JNC. Transformation of the candidate genes into canola is in progress.

Soil fumigation with Vapam for clubroot [*Plasmodiophora brassicae*] control in canola. K.A. ZUZAK, S.F. HWANG, G.D. TURNBULL, V. MANOLII AND S.E. STRELKOV. *Department of Agricultural, Food and Nutritional Science, 410 Agriculture/ Forestry Centre, University of Alberta, Edmonton, AB T6G 2P5, Canada; and (S.F.H., G.D.T.) Crop Diversification Centre North, Alberta Agriculture and Rural Development, 17 507 Fort Road N.W., Edmonton, AB T5Y 6H3, Canada.*
Clubroot is an important soilborne disease of canola in Alberta and continues to spread through the province. Soil fumigation could prove to be an effective tool to eradicate localized clubroot infections and new infection foci, in order to limit disease spread. Vapam is a liquid metam sodium solution applied to soil for the control of weeds, nematodes, insects and soil-borne diseases in crops. We analyzed the efficacy of various Vapam application rates for the control of clubroot of canola at two heavily infested field locations in Edmonton, Alberta. Disease severity, plant weight and height, and gall weight were measured in a clubroot-susceptible canola cultivar grown in the Vapam-treated soil. Preliminary results from one of the field locations suggest that Vapam may provide pronounced control of clubroot at label rates or higher. The same sites will be sown to the same canola cultivar next year to assess the residual effects of the Vapam treatments. In addition, new field sites will be added in 2013 to replicate the initial experiment using the same concentrations of Vapam.

Poster Presentations:

Frequent cropping to field pea increases root and foliar disease severity. K.A. BASSENDOWSKI, G.P. LAFOND, W.E. MAY, C.B. HOLZAPFEL, AND B.D. GOSSEN. *Agriculture and Agri-Food Canada (AAFC), Saskatoon Research Centre, 107 Science Place, Saskatoon, SK, Canada S7N 0X2; (G.P.L., W.E.M. and C.B.H.) AAFC, Indian Head Research Farm, R.R. #1, Government Road, Indian Head, SK, Canada S0G 2K0.*
Producers are interested in increasing the frequency of field pea (*Pisum sativum* L.) in cropping rotations on the Canadian prairies because of its economic and agronomic benefits, but there is concern that increasing intensity from the current recommendation of one crop in four will also increase disease risk. Field trials were conducted at Indian Head, SK from 1998 to 2011 to evaluate three crop rotations with field pea (P) and spring wheat (W): P-P, W-P, and W-W-P. Agronomic performance and severity of root and foliar diseases were assessed each year. Cropping rotation did not affect pea seedling establishment or crop density. However, root rot was more severe in P-P than the other rotations, and *Fusarium* spp. were the dominant pathogen(s) isolated. Mycosphaerella blight (*Mycosphaerella pinodes* (Berk. & Blox.) Vestergr. was the dominant (often the only) foliar disease. Mycosphaerella blight was more severe in the P-P rotation than in the other two rotations. Similarly, seed yield in the P-P rotation was lower than in W-P or W-W-P. This indicates that the high level of disease in the P-P rotation reduced yield, and that disease risk is increased by intensive pea production. However, several cycles of a cereal-pea rotation might be feasible in many parts of the prairie region.

Identification and mapping of a novel clubroot resistance gene (*Rpb1*) in *Brassica rapa.* M. CHU, F. YU, K.C. FALK, X. LIU, X. ZHANG, A. CHANG AND G. PENG. *Saskatoon Research Centre, Agriculture and Agri-Food Canada, 107 Science Place, Saskatoon, Saskatchewan S7N 0X2, Canada*
Clubroot, caused by *Plasmodiophora brassicae* Woronin, is a serious threat to canola (*Brassica napus* L.) production in western Canada. Varietal resistance is the most effective and practical strategy for clubroot control on canola, but few sources of resistance are currently available. To broaden the base of resistance, over 1000 lines of *Brassica* spp. were evaluated for clubroot resistance under controlled conditions. A line (FN) of *B. rapa* L. subsp. *chinensis* (pak choy) showed resistance to each of the five *P. brassicae* pathotypes identified in Canada. Segregating populations (test-cross and F_2) were made by crossing FN with a susceptible double-haploid *B. rapa* canola line (ACDC) for identification and mapping of clubroot resistance (CR) genes. Genetic analysis of the segregating F_2 and test-cross populations revealed that resistance to pathotype 3 of *P. brassicae* segregated in a 3:1 and 1:1 ratio, respectively, indicating that resistance to clubroot disease in FN is controlled by a single dominant gene. A total of 318 microsatellite markers were used to screen for polymorphism between the parental lines. The CR gene *Rpb1* was mapped to *B. rapa* linkage group A3, flanked by markers sN8591 and sR6340I in an interval of 1.2 cM based on the marker analysis over a test-cross population consisting of 1299 individuals. Molecular markers linked to *Rpb1* are available for use in marker-assisted selection to introgress this CR gene into *B. rapa* and *B. napus* canola.

The race structure of *Leptosphaeria maculans* in commercial canola fields based on 2010 disease surveys in Manitoba and Saskatchewan. D.J. CROSS, S.H. LIBAN, G. PENG, W.G.D. FERNANDO, H.R. KUTCHER, F.Q. YU, C. KIRKHAM, F.L. DOKKEN-BOUCHARD, D. McLAREN AND A. KUBINEC. *(D.J.C., C.K.) Agriculture and Agri-Food Canada (AAFC), Melfort, SK S0E 1A0, Canada; (S.H.L., W.G.D.F.) Department of Plant Science, University of Manitoba, 66 Dafoe Road, Winnipeg, MB R3T 2N2, Canada; (G.P., F.Q.Y.) AAFC Saskatoon, Saskatoon Research Centre, 107 Science Place, Saskatoon, SK S7N 0X2, Canada; (H.R.K.). Department of Plant Sciences, University of Saskatchewan, 51 Campus Drive, Saskatoon, SK S7N 5A8, Canada; (F.L.D.) Saskatchewan Ministry of Agriculture, 3085 Albert Street, Regina, SK, S4S 0B1, Canada; (D.M.) AAFC Brandon Research Centre, 18th Street North and Grand Valley Road, Brandon, MB R7A 5Y3, Canada; (A.K.) Manitoba Agriculture, Food & Rural Initiatives, 65-3rd Avenue NE, Carman, MB R0G 0J0, Canada.*
Blackleg disease of canola (*Brassica napus* L.), caused by *Leptosphaeria maculans* (Desmaz.) Ces. & De Not., is responsible for significant yield loss of oilseed rape and canola worldwide. In western Canada, the disease has been controlled successfully since the 1980's with use of varietal resistance and extended crop rotations. However, changes in the virulence of the *L. maculans* population have been reported recently, which may affect the effectiveness of certain resistant canola cultivars and consequently the disease impact. Samples collected during the 2010 survey of canola diseases in commercial fields in Manitoba and Saskatchewan were analyzed to assess the race structure of *L. maculans*. A set of 15 Brassica host differentials with 9 known resistance genes, *Rlm1-Rlm4, Rlm7, Rlm9,* and *LepR1-3* that can individually determined to be present and one differential that has *Rlm5, Rlm6* combined was used to identify avirulence

genes (*Avr*) of the pathogen in a gene-for-gene manner. A total of 299 isolates of *L. maculans* was evaluated, and *AvrLm1, 3, 9* and *AvrLep1,2* showed a frequency of 0-8% in the pathogen population. The low frequency of these *Avr* genes indicates that the corresponding resistance genes *Rlm1, Rlm3, Rlm9, LepR1* and *LepR2* are ineffective against blackleg in either provinces, while the *Rlm2, Rlm4, Rlm5, Rlm6, Rlm7*, and *LepR3* are still of a value. By determining the avirulence alleles in the population of *L. maculans,* races capable of overcoming host resistance may be identified.

Changes in ROS and lignin associated with progression of *Plasmodiophora brassicae* (clubroot) from cortical to stele cells. A DEORA, B.D. GOSSEN, AND M.R. McDONALD. *Department of Plant Agriculture, University of Guelph, Guelph, ON, N1G 2W1, Canada; (B.D.G.) Agriculture and Agri-Food Canada, Saskatoon Research Centre, Saskatoon, SK S7N 0X2, Canada.*
Plasmodiophora brassicae Woronin completes its life cycle in two phases; the first in root hairs and the second in the root cortex and stele. Differences in reactive oxygen species (ROS) and lignin in the root tissue of clubroot-resistant and susceptible cultivars of canola (*Brassica napus* L.) were assessed in sections stained with diaminobenzidiene (DAB) and toludiene blue O (TBO), respectively, at 5 wk after inoculation. Pathogen development was also assessed in comparable root sections stained with methylene blue. The pathogen was not observed in root sections of the resistant cultivars (secondary phase did not progress) or the susceptible controls. However, the pathogen preferentially colonized xylem parenchyma in the stele of susceptible cultivars. ROS accumulated primarily in the endodermis, pericycle and vascular cambium in both the resistant cultivars and the susceptible controls. In contrast, there was no accumulation of ROS in clubroot-infected roots of susceptible cultivars. Accumulation of ROS may create a chemical barrier that the pathogen is able to detoxify in susceptible plants. TBO staining showed that the walls of parenchyma cells stained blue in resistant and control plants; but were purple in infected areas of the roots of susceptible cultivars. The difference in color indicates an alteration in lignin composition in secondary cell walls.

Effect of soil type and compaction on severity of clubroot (*Plasmodiophora brassicae*). B.D. GOSSEN, H. KASINATHAN, M.R. McDONALD, AND G. PENG. *Agriculture and Agri-Food Canada, Saskatoon Research Centre, Saskatoon, SK S7N 0X2, Canada; (H.K., M.R.M.) Department of Plant Agriculture, University of Guelph, Guelph, ON, N1G 2W1 Canada*.
Studies were conducted under controlled conditions to examine the effect of soil type on clubroot caused by *Plasmodiophora brassicae*. Combinations of three factors: soil type (muck soil, pH 6.2; mineral soil, pH 6.8; non-calcareous sand, pH 6.5; soil-less mix, pH 6.0), pathotype (P3, P6; William's system), and biofungicide (Serenade, a.i. *Bacillus subtilis*; Prestop, a.i. *Gliocladium catenulatum*) were examined in a trial on canola (*Brassica napus*) and another on Shanghai pak choy (*B. rapa* subsp. *Chinensis* var. *communis*). Seedlings were treated with Serenade (5% v/v) or Prestop (7.5 g L^{-1}) at 5 days after germination and inoculated with *P. brassicae* 3 days later. Clubroot symptoms were assessed at 6 wk after inoculation. A third trial examined the impact of compaction on clubroot severity on canola. Each experiment consisted of four replicates, and

each was repeated. Clubroot incidence and severity were slightly but consistently higher in Shanghai pak choy than canola, and inoculation with P3 resulted in slightly more clubroot than P6. Clubroot levels in soil-less mix were lower than in the other soil treatments, but there was little difference among the three soils. The biofungicides reduced clubroot, but the reduction was generally small and inconsistent. Clubroot severity increased substantially with increasing soil compaction. This indicates that soil type likely has a smaller impact on clubroot that level of compaction when the soil is saturated, e.g., after heavy or prolonged precipitation.

Transcriptome changes of canola in response to *Heteroconium chaetospira*, an endophytic biocontrol fungus, against clubroot. R. LAHLALI, G. PENG, L. McGREGOR, F. YU, W. ZHANG, I. PARKIN, M.R. McDONALD, AND B.D. GOSSEN. *Agriculture and Agri-Food Canada, 107 Science Place, Saskatoon, Saskatchewan S7N OX2 Canada; (M.R.M)Department of Plant Agriculture, University of Guelph, Guelph, Ontario N1G 2W1, Canada*
Clubroot disease, caused by the pathogen *Plasmodiophora brassicae* Woronin, is a serious threat to canola (*Brassica napus* L.) production in western Canada. Application of *Heteroconium chaetospira* (Grove) M.B. Ellis, a possible fungal biocontrol agent delivered in a granular formulation, suppressed clubroot disease by >80% in controlled-environment conditions. This fungus showed no antibiosis against three soil fungal pathogens in a dual-culture assay. Colonization of canola roots by *H. chaetospira* was assessed using quantitative PCR (qPCR) with species-specific primers and observed via confocal microscopy. *Heteroconium chaetospira* penetrated the epidermal layer and colonized the root cortex, but no root-hair infection was observed. Microarray analysis of canola root tissue showed that the expression of 316 genes increased (P <0.05) after fungus treatment. Most of these genes with known putative functions were those related to plant metabolism (15%) or stress/defence (10%). Select genes involved in the ethylene, jasmonic acid, phenylpropanoid, chitinase, and PR-protein pathways were further analyzed using qPCR. The genes encoding peroxidase-7 precursor, ethylene receptor, endoglucanase-17 precursor, chitinase-like protein, 12-oxophytodienoate reductase, 4-hydroxyphenylpyruvate dioxygenase and cytochrome P450 were up-regulated significantly in canola roots treated with *H. chaetospira*. These genes were also up-regulated in the fungus-treated roots challenged with *P. brassicae* compared to the control inoculated with clubroot alone. The level of gene expression generally dropped in the treated roots at 14 and 21 days after treatment relative to that at 7 days. These results indicate that *H. chaetospira* is able to colonize canola roots and may stimulate resistance to clubroot via rapid up-regulation of genes involved in host defence-related pathways.

Characterization of the fungi associated with ascochyta blight of field pea in Alberta, Canada. J. LIU, T. CAO, J. FENG, K.F. CHANG, S.F. HWANG, AND S.E. STRELKOV.
Ascochyta blight, caused by a complex of *Mycosphaerella pinodes*, *Phoma pinodella*, *Ascochyta pisi*, and/or *P. koolunga*, is a devastating disease of field pea. In order to understand the composition of fungi associated with ascochyta blight in Alberta, Canada, a total of 157 single-spore fungal isolates, which were obtained from diseased pea samples collected from central and northern Alberta in 2011, were characterized for species identity, aggressiveness, DNA sequence

variation in the internal **transcribed** spacer (ITS) region, and **random amplification of polymorphic DNA (RAPD) patterns**. The ITS sequences obtained from 142 fungal isolates were all identical to the ITS sequences from *M. pinodes* and/or *P. pinodella*. Inoculation of the 157 isolates on a susceptible pea cultivar Midas indicated that most of the isolates were moderately to highly aggressive. Phylogenetic analysis based on the RAPD data revealed two main groups and six sub-groups, with one main group comprising 78% of the 157 isolates. Distinct RAPD patterns were associated with isolates from particularly geographic locations, but not with isolate aggressiveness.

A comparison of clubroot resistance in Brassica vegetable crops. M.R. McDONALD, K. SHARMA, A.M. VAN DEN NIEUWELAAR, AND B.D. GOSSEN. *Department of Plant Agriculture, University of Guelph, Guelph, ON, N1G 2W1 Canada; (B.D.G.) Agriculture and Agri-Food Canada, Saskatoon Research Centre, Saskatoon, SK S7N 0X2 Canada.*
Clubroot of crucifers, caused by the protist *Plasmodiophora brassicae* Woronin, is responsible for major yield losses in vegetable Brassica crops. Cultivars of several Brassica crops with resistance to clubroot have been developed recently. This study compared clubroot incidence and severity on resistant (R) and susceptible (S) cultivars of broccoli, Brussels sprouts and Shanghai pak choy grown in field soil naturally infested with pathotype 6 of *P. brassicae*, and on the same cultivars grown under controlled conditions and inoculated with pathotype 6 or pathotype 3. In the field trials, broccoli cv. Emerald Jewel (R) was compared to cv. Diplomat (S) in 2010 and 2011, Brussels sprouts cv. Crispus (R) with Jade Cross E (S) in 2011, and Shanghai pak choy line B 2834 (R) with cv. Mei Qing Choy (S) in 2011. In the field trials, all of the susceptible vegetables had 100% clubroot incidence and very high severity. The resistant Shanghai pak choy and Brussels sprouts had no symptoms of clubroot, while the resistant broccoli had a low severity rating (10–14%). Each of the resistant cultivars had higher yield or shoot weight than the susceptible cultivar of the same crop. Under controlled conditions, the reaction to pathotype 6 was consistent to the field assessments, and resistance or susceptibility was similar for pathotype 3. Growing clubroot resistant cultivars appears to be an effective method for managing clubroot on Brassica vegetables.

Reaction of lines of Arabidopsis and the Rapid Cycling Brassica Collection to Canadian pathotypes of *Plasmodiophora brassicae*. K. SHARMA, B.D. GOSSEN, AND M.R. McDONALD. *Department of Plant Agriculture, University of Guelph, Guelph, ON, N1G 2W1, Canada; (B.D.G.) Agriculture and Agri-Food Canada, Saskatoon Research Centre, Saskatoon, SK S7N 0X2, Canada.*
Clubroot, caused by *Plasmodiophora brassicae* Woronin, is a serious constraint to canola (*Brassica napus* L.) production in areas of the Canadian prairies. The objective of this study was to assess the reaction of lines of *Arabidopsis thaliana* and the Rapid Cycling Brassica Collection (RCBC) to the pathotypes of *P. brassicae* present in Canada. The clubroot reaction of 86 lines of *Arabidopsis* and 5 lines of RCBC (*B. carinata* L., *B. juncea* L., *B. napus, B. oleracea* L., *B. rapa* L.) were evaluated for their reaction to pathotypes 2, 3, 5 and 6 (William's system). A highly susceptible Brassica vegetable (Shanghai pak choy cv. Mei Choy, *B. rapa* var. *communis*) was

included as a control. Seedlings were grown individually in soil-less mix, inoculated with 3 x 10^6 resting spores of *P. brassicae*, and maintained at 25º/20º C day/night. Seedlings were assessed for clubroot incidence and severity at 6 wks after inoculation using a 0–3 scale. In *Arabidopsis*, most of the lines were susceptible to each of the pathotypes and no line was resistant to all of the pathotypes assessed. Lines with a differential reaction to pathotype were generally moderately resistant, rather than immune. The RCBC lines displayed a strong differential response to the pathotypes. These results indicate that lines of *Arabidopsis* and RCBC may have potential for use in a new differential set to characterize Canadian pathotypes of *P. brassicae*.

Integrated disease management of leaf spots and crown rust of oats. J. TAYLOR, C. KIRKHAM, J. WOYTOWICH, T. DAMENT, G. PENG AND H.R. KUTCHER. *Crop Development Centre, University of Saskatchewan, 51 Campus Drive, Saskatoon, SK S7N 5A8, Canada; (C.K.) Agriculture and Agri-Food Canada, Box 1240, Melfort, SK S0E 1A0; (G.P.) Agriculture and Agri-Food Canada, 107 Science Crescent, Saskatoon, SK S7N 0X2*
Crown Rust (*Puccinia coronata Corda* f. sp. *avenae* Eriks) and leaf spots (*Pyrenophora avenae* Ito & Kuribayashi and *Phaeosphaeria avenae* (Weber) Eriks) on oats can cause reduction in yield and quality. The objective of this study was to determine the effects of these diseases on oat cultivars varying for resistance to crown rust, and the impact of the registered fungicides propiconazole (Bumper®) and pyraclostrobin (Headline®), as well as a product (Actigard®) known to stimulate plant defense reactions to provide systemic acquired resistance, but has no direct activity on target pathogens. Two field experiments were established at each of Saskatoon and Melfort, SK in randomized complete blocks. At Saskatoon disease consisted almost entirely of crown rust, while at Melfort no crown rust was observed, only leaf spots. Experiment 1 consisted of three oat varieties: AC Morgan (crown rust susceptible), CDC Dancer (intermediate) and CDC Morrison (resistant) and three fungicide treatments: check (unsprayed), propiconazole and pyraclostrobin, applied at the flag leaf fully unfurled stage. Experiment 2 consisted of the application of Actigard at two rates of product: 8.75 g a.i./ha and 26.25 g a.i./ha, and four crop growth stages: check (unsprayed), seedling, boot and heading on each of two varieties: CDC Dancer and CDC Morrison. In Experiment 1 at Saskatoon, both propiconazole and pyraclostrobin effectively reduced crown rust severity and increased yield of AC Morgan. Increased yield was correlated with increased test weight and thousand kernel weight. Results of fungicide application were similar, but less dramatic for CDC Dancer. CDC Morrison had no visible symptoms of crown rust and yield appeared to be decreased by fungicide at this single site-year. Yield of CDC Morrison was greater than either AC Morgan or CDC Dancer if fungicide was not applied, and CDC Morrison without fungicide was greater than AC Morgan with fungicide and similar to CDC Dancer with fungicide. In Experiment 2 at Saskatoon, no differences among treatments for crown rust severity or for yield were observed for either rate of Actigard or application timings on either cultivar. Results from Melfort were not yet analysed as of abstract submission time.

Inoculum density effects and quantitative detection of *Rhizoctonia solani* (AG2-1) on canola.
Q.X. ZHOU, S.F. HWANG AND S.E. STRELKOV. *Crop Diversification Centre North, Alberta Agriculture and Rural Development, Edmonton, AB, T5Y 6H3, Canada; and (S.E.S.) Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, AB T6G 2P5, Canada.*
Rhizoctonia solani is one of the major pathogens causing seedling blight and damping-off of canola, diseases that can result in significant yield losses. The impact of inoculum density on seedling blight severity was evaluated. Canola was sown into soil inoculated with various concentrations of a highly aggressive isolate (R007) of *R. solani* classified as (Anastomosis Group) AG2-1, and monitored for emergence, plant height, and total dry matter produced. All three parameters decreased while disease severity increased with increasing inoculum density. A real-time PCR-based diagnostic assay was developed to quantify the amount of *R. solani* AG2-1 inoculum present in soil samples. A primer set and TaqMan probe were designed and shown to be specific for *R. solani* AG2-1, and under the specific reaction conditions evaluated could detect as little as 100 fg of the fungal genomic DNA. The amount of DNA detected by real-time PCR was highly correlated with *R.solani* (AG2-1) inoculum density in the soil samples.

Developing a quantitative PCR detection system for *Sclerotinia sclerotiorum* on canola petals. B.R. ZIESMAN, T.K TURKINTON, U. BASU AND S.E. STRELKOV. *(B.R.Z., U.B., S.E.S.), Dept. Agricultural, Food and Nutritional Science, University of Alberta, 410 Agriculture/Forestry Centre, Edmonton, AB, T6G 2P5, Canada; and (T.K.T.) Lacombe Research Centre, Agriculture and Agri-Food Canada, 6000 C&E Trail, Lacombe, AB, T4L 1W1, Canada.*
Sclerotinia stem rot of canola is a sporadic disease caused by the necrotophic fungus *Sclerotinia sclerotiorum* de Bary. As a result of its dependence on favourable environmental conditions for disease development, stem rot is sporadic in nature, but under conducive conditions can result in yield losses greater than 50%. Currently, stem rot is controlled primarily with routine application of fungicides, often applied without any reliable indication of disease risk. To reduce the use of fungicides when disease risk is non-economical, or conversely, to identify those fields at high risk, a timely and reliable forecasting system is needed. A positive correlation has been generally noted between petal infestation and final stem rot severity. As a result, a qPCR assay based on petal infestation will provide useful information on which growers may be able to base their spray decisions. Primers based on a hypothetical novel protein that is predicted to be a virulence factor for *S. sclerotiorum* have shown promise for the development of such a qPCR assay. The assay is specific to *S. sclerotiorum* and can reliably detect up to 10.4pg of mycelial DNA or 100 ascospores, showing promise as the basis for a qPCR-based stem rot forecasting system.

Minutes from the Business Meeting – 33rd Annual Meeting of the PPSA
November 6, 2012 Wayside Inn Lloydminster, Alberta
8:30-9:30 AM

President – Bruce D. Gossen
Secretary-Treasurer – Syama Chatterton (Scott Erickson acting)

1. **Adoption of the Agenda.**
   There were no changes or amendments.
   - A motion to adopt the agenda was moved by Bruce Gossen and seconded by Noryne Rauhala. Approved.

2. **Adoption of the Minutes of the 2011 Business Meeting**
   There were no changes or amendments suggested.
   - A motion to adopt the agenda was moved by Bruce Gossen and seconded by Noryne Rauhala. Approved.

3. **In Memoria**
   None

4. **Interim Financial Report**
   A financial summary for 2012 was presented by Noryne Rauhala, PPSA Treasurer, and a copy of this report is included with the minutes. It showed an account balance of $4001.09 as of October 31. The investment accounts both mature in December, and the intent will be to roll them up into one fund at that time. Bruce Gossen noted that the Wayside Inn has been very helpful in accommodating last minute changes due to the AAFC travel directive. About 15 people were unable to attend that normally would have. The hotel's flexibility has helped the Society avert a potential financial disaster.
   - A motion to accept the financial report was moved by Noryne Rauhala and seconded by Mike Harding. Approved.

5. **Reports of Standing Committees**

Disease Survey Committee: Mike Harding noted that in the 2012 canola survey there was an increase in aster yellows, that sclerotinia was moderate to severe, and that there was some blackleg found. Bruce Gossen reported that aster yellows was also found in Saskatchewan on canola and other crops, and sclerotinia occurred in pockets. Noryne Rauhala mentioned that there was a dramatic increase in application of fungicides in 2012. Ron Howard reported that clubroot has now been found in several hundred fields, and that it is spreading, being found in five new counties and along the Highway 16 corridor. Another unusual occurrence of clubroot was documented on a few infected plants of volunteer canola in a stubble field near Oyen. Identification was confirmed by PCR but the symptoms were not typical compared to what has been seen previously in Alberta. Bruce Gossen mentioned that at the Western Forum meetings, Byron Puchalski reported that stripe rust was widespread early in the field season, and there was a lot of spraying for that. There was no provincial fusarium survey this year, but the disease was still present. Ron Howard reported that a provincial pest surveillance system is in development that would function as a database of survey and diagnostic results, and could include historical data. Scott Erickson reported that in their 2012 dry bean survey, bacterial blights were found but sclerotinia was generally low this year. Bruce Gossen reported on their pea survey, which found high occurrence of root rots, especially in southern areas. He also reported that *Aphanomyces* was found on pea for the first time, with Sabina Banniza confirming the identification by qPCR.

Historical Committee: None.

Awards Committee: Ron Howard provided a printed report as well as proposed revised terms of reference for the Swanson award, both of which are included with the minutes.

- Ron Howard moved acceptance of the revised terms of reference for the Swanson award. Seconded by Bruce Gossen. Approved.
- A motion was put forward by Ron Howard to increase the amount of the Swanson award from $500 annually to $1000 annually effective 2012, and to move the necessary funds from the GIC to the daily interest account to accommodate the increase. Seconded by Noryne Rauhala. Approved.

6. **Conference Reports**

None.

7. **Reports on Unusual or Exceptional Disease Situations**

Bruce Gossen reported that the Western Forum meetings noted aster yellows on a wide range of crops including cereals.

8. Nomination of Honorary Life Members

No nominations were put forward. Bruce Gossen noted the need for publication of a life membership list. Ron Howard agreed to generate a list from the minutes of the Society as an early retirement project, probably in the next couple of years.

- Ron Howard moved that the chair send a letter of congratulations to Dr. Ieuan Evans on his induction into the Alberta Agriculture Hall of Fame. Seconded by Bruce Gossen. Approved.

9. Resolutions

- Ron Howard moved that the Organizing Committee be thanked for their efforts, and that the Wayside Inn be thanked for hosting the meeting. Seconded by Mike Harding. Approved.

10. Locations and Dates of Future Meetings

- Next year's meeting will be held in Brooks on dates to be announced as early as possible. The 2014 meeting is planned for Lacombe.

11. Election of Officers for 2011-12

The new officers will be: President: Mike Harding; Vice President: Kelly Turkington; Secretary/Treasurer: Syama Chatterton; Regional Representatives: Robyne Bowness, Ralph Lange, and Larry Kawchuk (if he is amenable; Mike Harding to contact him).

- Moved by Mike Harding to elect the new officers. Seconded by Ron Howard. Approved.

12. Other Business

None.

13. Adjournment

Moved by Mike Harding. Carried.

Report on the
SWANSON AWARD FOR PLANT PATHOLOGY AND NEMATOLOGY
November 6, 2012

The 2012 Swanson Award for Plant Pathology and Nematology will be presented to a graduate student from the University of British Columbia. The University is in the process of selecting a suitable candidate and will notify the PPSA Awards Committee of their choice once the adjudication process has been completed. A nomination letter, along with a curriculum vitae and academic transcript, will be reviewed by the Awards Committee to confirm that they meet the eligibility criteria for the scholarship. Once approved, a cheque for $500 and diploma will be presented to the awardee at a special ceremony at UBC.

A financial statement for the Scholarship Fund for 2011-12 is given below.

Guaranteed Investment Certificates (Community Savings, Lacombe)

16-month GIC (matures April 12, 2013)	$12,231.46
Interest Earned (2011-12) 1.45%	$ 127.96
Closing Balance (April 12, 2012)	$12,359.42

Daily Interest Savings Account (Community Savings, Lacombe)

Commercial Cash Anytime	$484.56
Interest 0.60%	$ 5.25
Donations received at PPSA 2011 annual meeting	$ 75.00
2011 Award (Alireza Akhavan, Univ. Alberta)	$500.00
Closing Balance (October 31, 2012)	$ 64.81

Respectfully submitted by D. Gaudet, S. Strelkov and R. Howard

Terms of Reference for the
SWANSON AWARD FOR PLANT PATHOLOGY AND NEMATOLOGY

Objective

The SWANSON AWARD FOR PLANT PATHOLOGY AND NEMATOLOGY recognizes excellence and career potential amongst graduate students in plant pathology and plant nematology.

Eligibility

Nominees for the award must be graduate students majoring in plant pathology or plant nematology at the University of Alberta (Edmonton), British Columbia (Vancouver) or California (Riverside). They need not be members of the PPSA or Canadian citizens, but must be registered as a full-time graduate student at one of the aforementioned institutions during the year in which he or she is nominated for the award.

Nomination Criteria

Nominees must exemplify all of the following qualities:

a) A high degree of career potential in applied research and/or extension in plant pathology or plant nematology.
b) A demonstrated ability to plan, conduct and interpret the results of applied research experiments.
c) A knowledge of commercial agriculture or forestry and a recognition of its economic importance in their home country.

Distribution

The award will be given out each calendar year, provided that a suitable candidate is nominated. No more than one Award will be presented per year. When possible, the Award will be presented in conjunction with the annual meeting of the regional plant pathology or nematology society of Alberta, British Columbia or California.

The rotational precedent established (British Columbia - California - Alberta) will be followed wherever possible, i.e. UBC - 2012, 2015, 2018; UAB - 2011, 2014, 2017; and UCR - 2010, 2013, 2016. In the event that a worthy candidate is not nominated at the university specified for a particular year, the Award will be forfeited and not awarded until the following year when another university is eligible for it.

Applications

Notice of the Award's availability and application procedures will be published in the Award calendars of the three designated universities. Candidates shall apply to their respective faculty Award committees in accordance with these procedures.

Evaluation of Candidates

Candidates for the Swanson Award will be evaluated by their respective university or faculty Award committee according to the criteria set out in these terms of reference. Each Award committee shall forward the name of their candidate, along with support documentation, to the PPSA Awards Committee for review. This documentation shall consist of:

a) A covering letter giving the name and address of the student and the reasons why he or she has been nominated. This letter should be submitted by the chairperson of the faculty Award committee.
b) A current curriculum vitae.
c) A transcript of the nominee's academic record for the period that they have been a graduate student at the university from which they have been nominated.

These documents should be submitted to the address given below no later than October 15th in the year in which the nomination is made.

Value and Form of the Award

The value of the Award will be $1000.00 in Canadian funds, which will be comprised of 75% of the accrued interest from the Award Fund earned during the year prior to the award, with the balance, if necessary, coming from the PPSA. A minimum of 25% of the annual interest earned by the Fund will be reinvested in it. The Award will be in the form of a money order made payable to the recipient, along with a suitably inscribed diploma certifying the award.

Donations to the Award Fund

Donations can be made to the Plant Pathology Society of Alberta at any time. Cheques or money orders should be made payable to the Society and donors should specify that the money is for the DR. TERRY SWANSON MEMORIAL FUND. Donations should be sent to the address given below. Official receipts will be issued for all donations.

Mrs. Noryne Rauhala
Agriculture and Agri-Food Canada/Agriculture et Agroalimentaire Canada
6000 C & E Trail
Lacombe, Alberta, Canada T4L 1W1
Telephone/Téléphone: 403-782-8184
Facsimile/Télécopieur: 403-782-8878
rauhalan@agr.gc.ca

Amendment of the Terms of Reference

These terms of reference can be amended by a simple majority vote of the members in good standing at any annual meeting of the PPSA.

2012.11.06

Plant Pathology Society of Alberta
Financial Summary October 2012

Opening Balance:			$5,654.13
Revenues			
Sponsorship	$3,300.00		
Registrations for 2011 meeting	$7,155.00		
Membership	$435.00		
Dr.Terry Swanson Memorial Scholarship Donations (2011)	$75.00		
Abstract Publication	$665.00		
Total Revenue	$11,630.00		
			$17,284.13
Expenses			
Student and Technician Awards ($100 each)		$300.00	
PPSA Graduate Student Scholarship		$500.00	
Abstract Publication		$455.00	
Meeting Expenses		$5,537.05	
Dr.Terry Swanson Memorial Scholarship Donations (2011)		$75.00	
Books from CPS		$1,875.00	
Miscellaneous		$180.99	
Transfer to GIC		$4,360.00	
Total Expenses		$13,283.04	
Balance			$4,001.09

PPSA Savings	Interest Rate	Interest Earned $	Amount
GIC - 16 month term Maturity Date December 22, 2013	1.50%	44.72	$10,587.55
Business 3 Year Escalator Maturity Date December 23, 2013	2.00%	$64.77	$4,684.45

Prepared by: Noryne Rauhala _____

Approved by: Robyne Bowness _____