ESA-PPSA-WF 2010
Plant Pathology Society of Alberta
31st Annual Meeting
Coast Lethbridge Hotel and Conference Centre
October 12-14, 2010
Program and Abstracts

PPSA Organizing Committee

André Laroche, Michele Frick, Denis Gaudet, Byron Puchalski,

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ESA-PPSA-WF 2010

Plant Pathology Society of Alberta – 31st Annual Meeting Program

Coast Lethbridge Hotel and Conference Centre

October 12-14, 2010

Tuesday, October 12th **Southern Room**

18:00 – 20:00	Registration
18:30 – 21:30	Welcome Mixer
18:00 – 20:00	Poster set-up (Velcro only)

Wednesday, October 13th **Southern Room**

07:30 – 08:30	Registration and Breakfast
07:30 – 08:30	Poster set-up (Velcro only)
08:30 – 08:45	Welcome

Contributed Paper Session 1 (Chairperson – Carolyn Penniket) **Southern Room**

08:45 **The reaction of western Canadian wheat and triticale varieties to stripe rust.**
B.J. Puchalski, D.A. Gaudet, H. Randhawa, R. Graf and T. Despins

09:00 **Transcriptome studies to improve stripe rust resistance in cereals.**
A. Laroche, Y. Xu, C. Badea, F. Tran, L. Robert, L. Harris, D. Thomas, N. Tinker, D. Gaudet and M. Frick.

09:15 **Stripe rust reactions of barley lines screened in international nurseries.**
K. Xi, K. Kumar, M. Holtz, K. Turkington, J. Nyachiro, P. Juskiw and J. Helm.

09:30 **Expression of 10R and MsrA2 antimicrobial peptides enhances FHB resistance in wheat transgenic lines.**
A. Badea, F. Eudes, A. Laroche, M. Frick, E. Amundsen, B. Puchalski and S. Misra.

09:45 **Comparison of the fungicide sensitivity of Alberta and Prince Edward Island isolates of *Fusarium graminearum* producing either 3- or 15-acetyl deoxynivalenol.**
T.K. Turkington, R. Clear, J. Gilbert, T. Nowicki, K.O'Donnell, A. Tekauz, T. Ward, A.P. Rooney, H. Klein-Gebbinck and R.A. Martin.

10:00 **Investigating the molecular mechanisms of Fusarium Head Blight resistance in wheat.**
N.A. Foroud, B.E. Ellis, T. Ouellet, J. Friedt, B. Oosterveen, M. Jordan, A. Laroche and F. Eudes.

10:15 -10:45 **Refreshment Break** **Southern Room**

10:45 – 12:00 **Contributed Poster Session 1 (Chairperson - Ana Badea)** **Southern Room**

P1. **Oxysilver nitrate is a broadly effective seed treatment for control of seed-borne, phytopathogenic fungi.**
M.J. Unruh, C.C. Fife, R.J. Howard and M.W. Harding.

P2. **Ratio of resistant to susceptible canola plants affects resting spore populations of *Plasmodiophora brassicae*.**
S.F. Hwang, H.U. Ahmed, Q. Zhou, S.E. Strelkov, B.D. Gossen, G. Peng and G.D. Turnbull.

P3. **The influence of temperature and pH on clubroot (*Plasmodiophora brassicae*) symptom development in canola under controlled environment conditions.**
H. Kasinathan, B.D. Gossen and M.R. McDonald.

P4. **Molecular markers identified that are linked to resistance or susceptibility of barley to scald.**
S. Xue, J. L. Zantinge, K.J. Steenbergen and P.E. Juskiw.

P5. **Effect of downy mildew on growth and yield loss in field pea.**
K.F. Chang, S.F. Hwang, S.E. Strelkov, B.D. Gossen, G.D. Turnbull and D.J. Bing.

P6. **Baseline sensitivity of *Ascochyta rabiei* to penthiopryad, a new SDHI fungicide.**
N. H. Thaher, B.D. Gossen and M.R. McDonald.

P7. **Evaluation of Brassica germplasm for resistance to clubroot of canola.**
G. Peng, K.C. Falk, B. James and R.K. Gugel.

P8. **Plant defense and drought tolerance genes interaction in triticale (x*Triticosecale* Wittm.) seedlings during osmotic stress.**
C. Badea, M. Frick, Y. Xu, O. Zabaneh, A. Comeau, R, Weselake and A. Laroche.

P9. **Efficacy of boron formulations against primary infection of *Plasmodiophora brassicae* in Shanghai pak choy.**
A. Deora, B.D. Gossen and M.R. McDonald.

12:00 – 13:00 **Lunch (provided)** **Southern Room**

Contributed Paper session 2 (Chairperson - Yuanyuan Wang) **Southern Room**

13:00 **NMR Structure Determination Offers Insights into the Mechanism for Toxicity of Trichothecenes T-2 and Deoxynivalenol.**
R. A. Shank, N. A. Foroud, P. Chaudhary, J. T. Goettel, T. Montina, P. Hazendonk, F. Eudes .

13:15 **Transcriptional analyses of cell wall development in Triticale for improved disease resistance.**
M. M. Frick, Y. Xu, C. Penniket, C. Graf and A. Laroche.

13:30 **The potential of oxidized forms of silver as durable, effective, broad-spectrum foliar fungicides**.
M.W. Harding, M.J. Unruh, C.C. Fife, R.J. Howard D.A. Sowa and M.E. Olson**.**

13:45 **A survey for strawberry diseases in Alberta.**
R.J. Howard, S.L.I Lisowski, G.C. Daniels, R.C.J. Spencer, T.A Forge and S. Sabaratnam.

14:00 **Relationship between blackleg symptoms and pathogen load in seed of susceptible and resistant canola cultivars.**
R.M. Lange, W. D. Dmytriw, D. Morton and K.D. Kenward.

14:15 **Cold-induced snow mould resistance in winter wheat.**
D.A. Gaudet, Y. Wang, M. Frick, C. Penniket, B. Puchalski, T. Ouellet, J. Singh, L. Robert and A. Laroche.

14:30-14:45 **Refreshment Break** **Southern Room**

14:45 – 16:00 **Contributed Poster Session 2 (Chairperson - Cosmin Badea)** **Southern Room**

P10. **Overwintering *Puccinia striiformis* in central Alberta.**
K. Kumar, K. Xi , M. Holtz, K. Turkington and D.Salmon.

P11. **Adaptation of *Puccinia striiformis* f. sp. *tritici* and f. sp. *hordei* to different temperatures**.
M.D. Holtz, K. Kumar and K. Xi.

P12. **Control of clubroot (*Plasmodiophora brassicae*) with microbial and synthetic fungicides.**
G. Peng, R. Lahlali, S-F. Hwang, M.R. McDonald; B.D. Gossen, R.H. Hynes and S.M. Boyetchko.

P13. **New races of sunflower downy mildew.**
K.Y. Rashid.

P14. **Transcript profiling of genes upregulated in the *Ruh1* incompatible interaction in Hannchen barley inoculated with *Ustilago hordei*, the covered smut pathogen.**
Y. Wang, D.A. Gaudet, C. Penniket, M. Frick, Z-X. Lu, G. Bakkeren and A. Laroche.

P15. **Production of non-specific esterase by conidia of *Peronospora viciae* f. sp. *pisi*.**
J. Feng, K.F. Chang, S.F. Hwang, S.E. Strelkov, B.D. Gossen, R.L. Conner and D.L. McLaren.

P16. **Effect of temperature on clubroot (*Plasmodiophora brassicae*) symptom initiation on Shanghai pak choy.**
K. Sharma, B.D. Gossen and M.R. McDonald.

P17. **Reaction to *Plasmodiophora brassicae* pathotype 6 in lines of *Brassica* species.**
K.C. Kalpana, M.R. McDonald and B.D. Gossen.

16:00 – 17:00	Discussion with Presenters	Southern Room
17:00 – 17:30	Poster Removal	Southern Room
17:45	Meet in lobby to walk to Georgio's	
18:00 – 21:30	Banquet	Georgio's Restaurant

Thursday, October 14th

07:00 – 09:00	Breakfast and AGM	Prairie Room

ESA-PPSA-WF 2010

Western Forum on Pest Management
Coast Lethbridge Hotel and Conference Centre
October 13-15, 2010

Wednesday October 13

17:30 - 21:30	Registration	Southern Room
19:30 - 21:30	Reception and snacks	Southern Room

Thursday October 14

07:30	Registration	Foyer
08:00 – 12:00	Western Committee on Crop Pests	Foothills Room
	Western Committee on Plant Disease	Southern Room
12:00	Lunch (provided)	
13:00 – 18:00	WCCP & WCPD Meetings Continued	
	Free evening	

Friday October 15 **ESA-PPSA-WFPM Joint Symposium** **Southern Room**
Arthropod - Microbe - Plant interactions

08:00 Opening and Welcome
Greg Pohl, President, ESA
André Laroche, President, PPSA
Héctor Cárcamo, President, WFPM

08:15 Introduction to the Symposium - Moderator Rob Bourchier

08:20 Olivier, C.Y
Phytoplasma research: a bridge between plant pathology and entomology

08:55 S.M. Boyetchko and R.K. Hynes
Development of soil bacteria for biological control of green foxtail.

09:30 D.K. Weaver, Z. Sun, A. Wenda-Piesik, W.E. Grey, A.T. Dyer and W.L. Morrill.
What's going on inside wheat stems? The interactions between pathogens and a nefarious herbivore

10:05 Coffee break

10:30 – 11:30 Western Forum of Pest Management Business Meeting Foothills Room

Plant Pathology Society of Alberta – 31st Annual Meeting Program 2010

Abstracts - Contributed Paper Session 1

The reaction of western Canadian wheat and triticale varieties to stripe rust. B.J. Puchalski, D.A. Gaudet, H. Randhawa, R. Graf and T. Despins. *AAFC Lethbridge Research Center, 5403 1st Avenue South, Lethbridge, AB, T1J 4B1 Canada*

Stripe rust (*Puccinia striformis*) is an important pathogen of wheat in western Canada. Infections generally are the result of urediniospores blown in from the Pacific Northwest U.S.A. during the spring and early summer. One hundred and four spring wheat and triticale varieties and ten winter wheat cultivars were evaluated in nurseries at Lethbridge and Creston B.C. Infection levels in all nurseries were high. Resistance occurred in all tested varieties in the triticale, amber durum, extra strong and soft white spring classes. Within the red Canada Prairie Spring (CPS) class, newer varieties were resistant but many of the older varieties were susceptible. Among the white CPS wheats, Vista is resistant whereas Snowhite 475 and Snowhite 476 are susceptible. Among the hard white wheats, only Karma was resistant whereas Snowstar and Snowbird were susceptible. Fifty-nine percent of the hard red spring wheats (CWRS) were resistant; much of the resistance was attributed to the presence of the *Yr17* and *Yr18* resistance genes. Susceptible CWRS varieties that are extensively seeded in western Canada include Barrie and Superb. Sixty percent of the varieties belonging to the Hard Red Winter class were resistant. Effectiveness of the *Yr10* gene in Radiant has been lost due to the apparent occurrence of a new race.

Transcriptome studies to improve stripe rust resistance in cereals. A. Laroche, Y. Xu, C. Badea, F. Tran, L. Robert, L. Harris, D. Thomas, N. Tinker, D. Gaudet and M. Frick. *Agriculture and Agri-Food Canada, Research Centre, 5403 1st Avenue South, Lethbridge, AB, T1J 4B1 Canada; and (F.T., L.R., L.H., N.T.) Agriculture and Agri-Food Canada, ECORC, 960 Carling Avnue, Ottawa, ON, K1A 0C6 Canada*

No sequence reference genomes are available for small grain cereals although such reference genomes are available for rice, corn sorghum and *Brachypodium distachyion*, a new model system for plant. Given the extremely large genome size of the small grain cereals, wheat (AABBDD), barley (HH), triticale (AABBRR), rye (RR), we have identified a reference transcriptome in triticale and rye. In this project, we obtained about 11 million 454 reads from different development stages and abiotic stress treatments of different tissues of triticale and rye. The de novo assembly led to the identification of a wheat/triticale/rye (wtr) transcriptome set of nr 83,000 elements which includes 53,728 non redundant FLcDNA, 19,687 nr cDNA of various lengths and 9,398 wtr nr cDNA specific to these three species. This provides us a scaffold to look at the complete plant response to stripe rust. Using the same technology, we are planning to characterize the prevalent strains of stripe rust on the Canadian prairies. This will be facilitated by the impending (August 2011) release of the 15x genome coverage of *P. striiformis* race PST-78 from the Broad Institute Inc. Our objectives are to develop a molecular fingerprint for prevalent races of stripe rust and to identify the molecular determinants of the new high temperature tolerant races.

Stripe rust reactions of barley lines screened in international nurseries. K. Xi, K. Kumar, M. Holtz, K. Turkington, J. Nyachiro, P. Juskiw, and J. Helm. *Field Crop Development Centre, Alberta Agriculture and Rural Development, 6000 C and E Trail, Lacombe, AB, T4L 1W1 Canada; and (K.T.) Agriculture and Agri-Food Canada, Lacombe Research Centre, 6000 C and E Trail, Lacombe, AB, T4L 1W1 Canada*

Barley stripe rust caused by *Puccinia striiformis* f. sp. *hordei* has frequently occurred in the breeding nurseries located in central Alberta and commercial fields in southern Alberta. To breed for resistance, a large amount of barley breeding and germplasm lines have been screened in the stripe rust nurseries in North and South America since 2007. Disease assessments in the nurseries were usually made twice each season by rating infection type and percentage area of diseased leaves and spikes. This screening generated a large amount of data from 2007 to 2009 that required analysis and subsequent interpretation. Principle component analysis was used to select data with satisfactory disease levels and those that similar rating scales were used and assessment timings. This was followed by canonical discriminant analysis to separate stripe rust reactions among barley classes screened in the nurseries. Analyses showed that the 2-row barley was generally more resistant than the 6-row class. Germplasm lines originally thought to have resistance were consistently more resistant than advanced breeding lines. The majority of Canadian barley cultivars screened were susceptible. A few of the tested cultivars were resistant. The significance of the screening results is discussed in relation to the selection of barley for resistance breeding.

Expression of 10R and MsrA2 antimicrobial peptides enhances FHB resistance in wheat transgenic lines. A. Badea, F. Eudes, A. Laroche, M. Frick, E. Amundsen, B. Puchalsky, and S. Misra. *Lethbridge Research Centre, Agriculture and Agri-Food Canada, 5403 1st Avenue South, Lethbridge, AB, T1J 4B1 Canada; and (S.M) Department of Biochemistry and Microbiology, University of Victoria, Victoria, BC, V8W 3P6 Canada*

Antimicrobial peptides (AMPs) are potent natural antibiotics and their activity has been demonstrated against various pathogens. We hypothesized that control of fusarium head blight (FHB) in wheat could be accomplished through *in vivo* expression of two synthetic AMPs (MsrA2 and 10R) that were previously reported active *in vitro* against a variety of *Fusarium* species and strains. Three tissue specific promoters were chosen for regulating the AMPs expression in the wheat epidermis (*GstA1),* lemma/palea (*Lem1)* and epicarp *(Ltp6).* Biolistic transformation and direct somatic embryogenesis were used to generate transgenic plants from cv. Fielder. The transgenic plants were evaluated in the greenhouse for resistance to FHB and powdery mildew. When compared to the non-transformed control Fielder, the transgenic lines showed on average a 49% and 58% reduction in FHB and powdery mildew susceptibility, respectively. Moreover, the transgenic plants showed on average a 34% reduction in DON accumulation compared to cv. Fielder.

Comparison of the fungicide sensitivity of Alberta and Prince Edward Island isolates of *Fusarium graminearum* producing either 3- or 15-acetyl deoxynivalenol. T.K. Turkington, R. Clear, J. Gilbert, T. Nowicki, K. O'Donnell, A. Tekauz, T. Ward, A.P. Rooney, H. Klein-Gebbinck, and R.A. Martin. *Lacombe/Beaverlodge Research Centre, Agriculture and Agri-Food Canada (AAFC), Lacombe AB, T4L 1W1 Canada; (J.G., A.T.) Cereal Research Centre, AAFC, 195 Dafoe Road, Winnipeg MB, R3T 2M9 Canada; (R.C., T.N.) Grain Research Laboratory, Canadian Grain Commission, 1404-303 Main Street, Winnipeg MB, R3C 3G8 Canada; (K.O., T.W., A.P.R.) United States Department of Agriculture (USDA), Peoria, IL, USA; and (R.A.M.) Charlottetown Research Centre, AAFC, 440 University Avenue, Charlottetown PEI, C1A 4N6 Canada*

Fusarium graminearum Schwabe of the '3ADON' chemotype is now displacing '15ADON' isolates in Canada, and that this shift in chemotype may be related to potential differences in fungicide sensitivity. Fungicide sensitivity was assessed for a total of 12 isolates of *F. graminearum*; three '3ADON' and three '15ADON' from each of Alberta and Prince Edward Island, Canada. Spezieller Nährstoffarmer (SN) agar plates or 96 well microplates with liquid SN media were amended with 0, 0.78, 2.16, 4.16, 9.00, 16.78, and 30.62 µg/mL of commercial tebuconazole (Folicur®). Agar plates were inoculated with mycelial plugs and colony diameters were measured after 72 hours at 20°C. Microplates were inoculated with homogenized mycelial plugs and absorbance at 405 nm was recorded for individual wells on each microplate using a Biotek microplate reader at time 0 and after 72 hours of incubation at 20°C. Results for both the agar plates and microplates were expressed as a percentage of the diameter or absorbance of the unamended control. For both experiments there were consistent significant effects due to fungicide rate for all runs. No significant differences were found due to chemotype in two of three runs of the agar plate experiment and in both runs of the microplate experiment. These results suggest that the '3ADON' and '15ADON' isolates tested had similar sensitivity to tebuconazole.

Investigating the molecular mechanisms of Fusarium Head Blight resistance in wheat. N.A. Foroud, B.E. Ellis, T. Ouellet, J. Friedt, B. Oosterveen, M. Jordan, A. Laroche and F. Eudes. *University of British Columbia, Michael Smith Laboratories, Vancouver, BC, V6T 1Z4 Canada; (N.A.F., J.F., A.L., F.E.) Agriculture and Agri-Food Canada, 5403 1st Avenue South, Lethbridge, AB, T1J 4B1 Canada; (T.O.) Agriculture and Agri-Food Canada, Ottawa, ON, K1A 0C6 Canada; and (B.O., M.J.) Agriculture and Agri-Food Canada, Winnipeg, MB, R3T 2M9 Canada*

Fusarium Head Blight is a disease of cereal crops caused by a group of trichothecene-producing *Fusarium* species. Two major forms of resistance to Fusarium Head Blight are Type 1 resistance (resistance to initial infection) and Type 2 resistance (resistance to disease spread). Using functional genomics approaches, the effect of FHB-elicitors on the defense response of three wheat genotypes that share the susceptible cv. 'Superb' pedigree were evaluated. Distinct differences were observed between the resistant genotypes and 'Superb', as well as between the Type 1 and Type 2 genotypes. The current data suggests that different molecular mechanisms exist not only between susceptibility and resistance responses, but also between different forms of genetic resistance. It is proposed that Type 1 resistance involves a combination of structural features that slow fungal penetration and activation of a systemic response in uninfected tissues adjacent to the site of infection to prevent or minimize secondary infection; whereas, Type 2 resistance is more likely a form of local resistance. Results from a follow up experiment, where wheat heads were primed with FHB elicitors and subsequently inoculated with a virulent *F. graminearum* strain and evaluated for changes in disease outcomes, corroborates this hypothesis. Furthermore, an analysis of the role plant hormone signaling using a combination of genetic and biochemical analysis supports a role for jasmonic acid signalling in contributing to Type 2 resistance.

Contributed Paper session 2

NMR Structure Determination Offers Insights into the Mechanism for Toxicity of Trichothecenes T-2 and Deoxynivalenol. R.A. Shank, N.A. Foroud, P. Chaudhary, J.T. Goettel, T. Montina, P. Hazendonk, F. Eudes . *Agriculture and Agri-Food Canada, Lethbridge, AB, T1J 4B1 Canada; (R.A.S., P.C., J.T.G., T.M., P.H.) University of Lethbridge, Lethbridge, AB, T1K 3M4 Canada.*

Fungal toxins, such as those produced by the *Fusarium* genus, have widespread effects on cereal crops. Among the most toxic are the trichothecenes, including T-2 toxin and deoxynivalenol (DON). These toxins stall protein synthesis through an interaction with the PTC of the Ribosome. The current proposed mechanism suggests a nucleophilic attack involving the epoxide ring; however, little is known about the internal dynamics of these molecules, and DFT calculations suggest that the epoxide is partially obscured. Solution and Solid State NMR refinements of the structure were able to determine the rigidity of the ring system, as well as the hydrogen bonding interactions present in these toxins. These preliminary studies provide new insight into the mechanism for toxicity within plant cells, and the interaction of these toxins with the ribosome.

Transcriptional analyses of cell wall development in Triticale for improved disease resistance. M. M. Frick, Y. Xu, C. Penniket, C. Graf and A. Laroche. *Agriculture and Agri-Foods Canada Research Center, 5403 1st Avenue South, Lethbridge, AB, T1J 4B1 Canada and (C.P.) University of Lethbridge, Lethbridge, AB, T1K 3M4 Canada*

Triticale, a man-made interspecific hybrid, is a high yielding crop with excellent adaptability to different environments. Because cell wall composition in dicots is not representative of that in monocots, triticale is being used as a model system for cellulosic composition and ethanol conversion for cereals. The cell wall composition also plays an important role in plant defence against both pathogens and insects. To gain some understanding of gene expression involved in triticale stem and cell wall development, we employed the Affymetrix GeneChip® Wheat Genome Array to study global gene expression during four stages of stem development and two stages of leaf development in AC Certa. Expression of candidate genes was confirmed by 454 sequencing data and quantitative Real-time PCR (qPCR). Regulated genes include biosynthetic, metabolic and transport genes, transcription factors including NAC domain transcription factors, and genes related cell wall metabolism and organization. An understanding of cell wall biosynthesis, the related genes and their corresponding expression profiles is crucial to aid in furthering our understanding of the role of the cell wall in plant defence strategies.

The potential of oxidized forms of silver as durable, effective, broad-spectrum foliar fungicides.
M.W. Harding, M.J. Unruh, C.C. Fife, R.J. Howard D.A. Sowa and M.E. Olson. *Innovotech Inc. Suite 101 -- 2011 94 St., Edmonton, AB, T6N 1H1 Canada; and (RJH) Alberta Agriculture and Rural Development, Crop Diversification Centre South, 301 Horticultural Station Rd. E., Brooks, AB, T1R 1E6 Canada*

Oxidized forms of silver, such as oxysilver nitrate and sodium diperiodatoargentate (III), are toxic to microorganisms at low concentrations (<50 ppm). We investigated their potential as foliar-applied fungicides against fungal diseases on field-grown pulse crops, e.g. ascochyta blight on chickpea (*Aschochyta rabiei* (Pass.) Labr.), mycosphaerella blight on pea (*Mycosphaerella pinodes* (Berk. & A. Bloxam) Vestergr.), and white mould on dry bean (*Sclerotinia sclerotiorum* (Lib.) de Bary). Small plots (c.a. 750m^2) of each crop were established in randomized complete block designs and treated with aqueous preparations of oxidized silver products, industry standard fungicides, and water as an untreated check. Oxidized silvers were capable of significantly reducing disease symptoms when applied as foliar sprays and in many cases were equivalent to industry standard fungicides.

A survey for strawberry diseases in Alberta. R.J. Howard, S.L.I. Lisowski, G.C. Daniels, R.C.J. Spencer, T.A Forge, and S. Sabaratnam. *Alberta Agriculture and Rural Development, Crop Diversification Centre South, 301 Horticultural Station Road East, Brooks, AB, T1R 1E6 Canada; (R.C.J.S.) Alberta Agriculture and Rural Development, Alberta Ag-Info Centre, Postal Bag 600, Stettler, AB, T0C 2L0 Canada; (T.A.F.) Agriculture and Agri-Food Canada, Pacific Agri-Food Research Centre, P.O. Box 1000, 6947 Hwy 7, Agassiz, BC, V0M 1A0 Canada; and (S.S.) British Columbia Ministry of Agriculture and Lands, Plant Health Unit, 1767 Angus Campbell Road, Abbotsford, BC, V3G 2M, Canada*

A general disease survey was carried out in selected strawberry (*Fragaria* x *ananassa*) plantings in southern and central Alberta in 2009-10. In each year, three farms were visited up to three times in order to assess the spectrum of diseases present at different growth stages. All of the farms were pick-your-own operations located close to urban centres. The incidence and severity of major infectious and non-infectious diseases were assessed at each visit, and soil and root samples were collected in late summer to determine the types and numbers of plant pathogenic nematodes present, if any. Plantings of both June-bearing (short day) and day-neutral (photoperiod insensitive) cultivars were examined. The most frequently encountered infectious diseases were bacterial leaf spot (*Xanthomonas fragariae*), leaf scorch (*Diplocarpon earlianum*), common leaf spot (*Mycosphaerella fragariae*), and powdery mildew (*Sphaerotheca macularis* f. sp. *fragariae*). Five genera of parasitic nematodes were extracted from soil and roots, which included *Pratylenchus, Paratylenchus, Xiphinema, Tylenchus* and *Heliotylenchus*. Population levels were generally below economic thresholds. Iron chlorosis, freezing injury, flooding damage and misshapen fruit were the most commonly seen abiotic problems. In most cases, infectious diseases were not a significant production constraint; however, reduced vigour and plant death caused by cold temperatures and excess rain significantly impacted stands and fruit yields in a few cases.

Relationship between blackleg symptoms and pathogen load in seed of susceptible and resistant canola cultivars. R.M. Lange, W.D. Dmytriw, D. Morton, and K.D. Kenward. *Alberta Innovates – Technology Futures, P. O. Bag 4000, Vegreville, AB T9C 1T4, Canada; and (D.M., K.D.K.) 20/20 Seed Labs Inc. # 201, 509 - 11 Avenue, Nisku, AB, T9E 7N5, Canada*

Leptosphaeria maculans, the causal agent of blackleg disease of canola, was detected by quantitative PCR (qPCR) in seed of *Brassica napus* plants grown in an artificially inoculated field nursery. A four-replicate field trial consisting of 21 spring *B. napus* canola cultivars was established in Vegreville, Alberta. Plots were inoculated by spraying a mixture of conidia from *L. maculans* isolates collected in east-central Alberta. The severity of disease symptoms was evaluated using a standard six point scale. Subsequently, seed from each cultivar was collected for DNA isolation and qPCR analysis. DNA was extracted directly from seed. Primers were developed to specifically differentiate *L. maculans* from *L. biglobosa* and other common fungal pathogens of *B. napus*. These primers were able to detect *L. maculans* at titres three orders of magnitude below those seen in qPCR assays using previously published primers. The qPCR estimates of *L. maculans* load in seed were positively associated with symptom severity of the source plants. Symptom severity and the quantity of pathogen DNA were lower in seed of resistant cultivars compared to susceptible cultivars, although *L. maculans* was detected in seed of all cultivars. Some cultivars previously rated as resistant to blackleg developed severe symptoms.

Cold-induced snow mould resistance in winter wheat. D.A. Gaudet, Y. Wang, M. Frick, C. Penniket, B. Puchalski, T. Ouellet, J. Singh, L. Robert and A. Laroche. *Agriculture and Agri-Foods Canada Research Centre, 5403 1st Avenue South, Lethbridge, AB, T1J 4B1 Canada; and (T.O., J.S., L.R.) Agriculture and Agri-Foods Canada Research Centre, Eastern Cereals and Oilseeds Research Centre, 1341 Baseline Road, Ottawa, ON, K1A 0C5 Canada*

Cold hardening of winter wheat at 2°C for 1–6 wks increased resistance to the snow mould pathogens LTB,*Typhula incarnata*, and *Microdochium nivale* as well as to powdery mildew (*Blumaria graminis* f. sp. *graminis*) and stripe rust (*Puccinia striiformis*). Using microarrays and hardening of winter wheat for 0.25, 0.5, 1, 7, 21 and 49 d, an upregulation of a wide range of stress-response genes that include defence-related and abiotic stress-related genes, transcription factors including several lipoxygenases and ethylene responsive factors, and WRKY genes was observed. For the majority of these genes, the upregulation occurred later in the 21–49 d hardening treatments and coincided with the highest expression levels of snow mould resistance. Defence-related sequences were upregulated to a greater extent and were more numerous in the snow mould resistant line CI14106 compared to cold hardy DH+268. Transcript profiling of candidate defence and other stress-related genes under prolonged conditions at −3 °C with or without snow mould infection showed that there was a decline in transcripts of the defence-related genes PR1.1 and NPR3 during the 12 wks incubation. Additionally, 14 d hardening was insufficient to permit full expression of the jasmonic acid synthesis gene, allene oxide synthase (AOS) and the fructan degrading enzyme β-fructofuranosidase compared the 42 d hardening treatment. The snow mould resistant line CI14106 was able to maintain higher transcript levels of AOS for longer conditions compared to the susceptible line Norstar under artificial snow mould conditions. These results explain the nature of cold-induced resistance to snow moulds and provide direction on establishing selection criteria for improving resistance and cold tolerance in winter

Contributed Poster Session 1

Oxysilver nitrate is a broadly effective seed treatment for control of seed-borne, phytopathogenic fungi. M.J. Unruh, C.C. Fife, R.J. Howard and M.W. Harding. *Innovotech Inc. Suite 101 -- 2011 94 St., Edmonton, AB, T6N 1H1 Canada; and (RJH) Alberta Agriculture and Rural Development, Crop Diversification Centre South, 301 Horticultural Station Rd. E., Brooks, AB, T1R 1E6 Canada*

Oxysilver nitrate (Agress®) had previously been demonstrated to be an effective seed treatment for controlling seed-borne bacterial diseases on pulse crops. We investigated the efficacy of Agress® against seed-borne fungal pathogens of potato and chickpea. Potato seed tubers were artificially inoculated with *Fusarium sambucinum* Fuckel (teleomporph *Giberella pulicaris* (Fr.) Sacc.) the causal agent of seed piece decay. Additionally, chickpea seed naturally infested with *Aschochyta rabei* (Pass.) Labr., the cause of ascochyta blight, was obtained. The inoculated/infested seed was treated with oxysilver nitrate or an industry standard fungicidal seed treatment and compared with a non-treated check. The treated seed was sown in replicated, small plot field experiments utilizing a randomized complete block design. For potatoes, the efficacy of the seed treatment versus seed piece decay was estimated by plant emergence. Efficacy on chickpea seed was estimated via foliar disease ratings for ascochyta blight. Results of the field trials demonstrated that Agress® was an effective seed treatment for control of seed-borne fungal diseases of potato and chickpea.

Ratio of resistant to susceptible canola plants affects resting spore populations of *Plasmodiophora brassicae*. S.F. Hwang, H.U. Ahmed, Q. Zhou, S.E. Strelkov, B.D. Gossen, G. Peng, and G.D. Turnbull. *Crop Diversification Centre North, Alberta Agriculture and Rural Development, Edmonton, AB, T5Y 6H3 Canada; (S.E.S.) Department of Agriculture and Forestry, University of Alberta, 410 Agriculture/Forestry Centre, Edmonton, AB, T6G 2P5 Canada; and (B.D.G. and G.P.) Saskatoon Research Centre, Agriculture and Agri-Food Canada, 107 Science Place, Saskatoon, SK, S7N 0X2 Canada*

Clubroot, caused by *Plasmodiophora brassicae* Woronin, is a growing threat to canola (*Brassica napus* L.) production in Canada. Clubroot-resistant canola cultivars have recently become available for commercial production in Alberta, but susceptible volunteer canola plants will continue to be present in infested fields for many years. An initial greenhouse study was conducted to assess root size, clubroot severity and resting spore production in a resistant and a susceptible canola cultivar. The two cultivars were planted separately in tubs of infested soil-less mix. Root mass was much greater for the susceptible cultivar and was correlated to index of disease (ID) values calculated from clubroot severity (0–3 scale). In a second study, the same cultivars were sown together to produce a range of proportions of resistant to susceptible plants (1:0, 3:1, 1:1, 1:3, and 0:1). At 6 wk after sowing, the roots were collected, rated for clubroot severity, then macerated and re-incorporated into the soil. The susceptible cultivar was grown in the re-inoculated soil and assessed after 6 wk. Root fresh weight increased and plant height decreased with increasing ID in the initial treatment (ratios of R:S plants). As expected, spore numbers were highest in soil planted with 100% susceptible plants and declined as the proportion of susceptible plants declined. We noted that 11% of the resistant canola plants developed clubroot symptoms. This may indicate that repeated cultivation of this cultivar will result in selection for pathogen phenotypes that can overcome this source of resistance.

The influence of temperature and pH on clubroot (*Plasmodiophora brassicae*) symptom development in canola under controlled environment conditions. H. Kasinathan, B.D. Gossen and M.R. McDonald. *Department of Plant Agriculture, University of Guelph, Guelph, ON, N1G 2W1 Canada; and (B.D.G.) Agriculture and Agri Food Canada Research Centre, Saskatoon, SK, S7N 0X2 Canada*

Clubroot is caused by the soil-borne biotrophic protist *Plasmodiophora brassicae* (Woronin). The interaction of temperature (10°, 15°, 20°, 25°, 30° C) and pH (6.0, 6.5, 7.0, 7.5, 8.0) on the development of clubroot symptoms in canola roots were studied in a trial under controlled environmental conditions arranged in a factorial randomized complete block design with three replicates. Individual seedlings were transplanted into tall plastic pots (10 pots per experimental unit) containing autoclaved, non-calcareous sand and watered with pH adjusted water using 5% acetic acid or 10% sodium hydroxide to attain desired pH. Each seedling was inoculated with 5 mL of a resting spore solution containing 1×10^6 spores/mL. Plants were destructively harvested 50 days after inoculation. Clubroot severity was assessed using a 0–3 scale, and a disease severity index (DSI, range 0–100%) was calculated. Clubroot severity was low (< 20% DSI) at 10° and 15° C, regardless of pH. The optimum temperatures for clubroot development were 20° to 25° C. The highest DSI (99%) was obtained at pH 6 and 25° C. DSI values were reduced at pH 8, but still high (42%) at 25° C. The canola plants did not grow well at 30° C and there are no data from this temperature. The data indicate that clubroot on canola is suppressed at high pH, but severe clubroot can still develop when other conditions are optimum.

Molecular markers identified that are linked to resistance or susceptibility of barley to scald. S. Xue, J.L. Zantinge, K.J. Steenbergen and P.E. Juskiw, *Field Crop Development Centre, Alberta Agriculture and Rural Development, 5030-50 Street, Lacombe, AB, T4L 18W, Canada*

Barley scald, caused by *Rhynchosporium secalis*, is prevalent in central Alberta and causes significant yield and quality losses in barley production. The barley breeding program at Lacombe has been trying to incorporate durable scald resistance into lines with good malting quality. Cultivar 'Seebe' is known to have durable resistance to scald and based on previous molecular marker studies the resistance appeared to be controlled by multiple genes. In order to develop scald resistance using marker-assisted-selection, we genotyped 100 F_6 recombinant inbred lines from the two-row malt barley breeding population J04075 (H93016013/Seebe) with 34 SSR or STS markers. The phenotyping of the lines for scald resistance was assessed in the field in 2009 at Lacombe. The QTL analysis of the marker data identified seven markers linked to the scald disease reactions and each marker accounted for 4.57 to 8 percent of the variation for scald severity. Of the five markers that were used in 2010 to genotype other barley breeding populations with cv 'Seebe' parentage background, Ebmac635 (450bp) was associated with susceptibility, while Bmag0189 (185bp), Gms27b (131bp), Gbm1456 (275bp), and Bmag0187 (187bp) were linked to resistance. Currently, we are conducting genetic mapping and validation studies for these markers.

Effect of downy mildew on growth and yield loss in field pea. K.F. Chang, S.F. Hwang, S.E. Strelkov, B.D. Gossen, G.D. Turnbull and D.J. Bing. *Alberta Agriculture and Rural Development (AARD), Lacombe, AB, T4L 1W8 Canada; (S.F.H., G.D.T.) AARD, Edmonton, AB, T5Y 6H3 Canada; (S.E.S.) University of Alberta, Edmonton, AB, T6G 2P5 Canada; (B.D.G.) Agriculture and Agri-Food Canada (AAFC), Saskatoon, SK, S7N 0X2 Canada; and (D.J.B.) AAFC, Lacombe, AB, T4L 1W1 Canada*

Downy mildew, caused by *Peronospora viciae* f.sp. *pisi*, has caused substantial damage to field pea crops in Alberta, particularly under the cool, wet conditions experienced in 2010. Healthy and diseased plants were sampled from an infested field in central Alberta on July 27, 2010, in order to evaluate the effect of downy mildew on early-season growth of the pea plants. Plant growth and pod size were reduced for each increase in disease severity. Four pea fields were also sampled later in the summer of 2010 to compare the yields of healthy and diseased plants taken from the same field. Pod numbers decreased and yield losses increased with increasing disease severity. Preliminary results suggest that even moderately severe cases of downy mildew can reduce pod growth by 65% and yield by 75%.

Baseline sensitivity of *Ascochyta rabiei* to penthiopryad, a new SDHI fungicide. N.H. Thaher, B.D. Gossen and M.R. McDonald. *Department of Plant Agriculture, University of Guelph, Guelph, ON, N1G 2W1 Canada; and (B.D.G.) Agriculture and Agri-Food Canada, Research Centre, Saskatoon, SK, S7N 0X2 Canada*

Ascochyta blight, caused by *Ascochyta rabiei* (Pass.) Labr., is a destructive disease of chickpea (*Cicer arietinum* L.). Repeated application of fungicide is required almost every year for blight management, and insensitivity to strobilurin fungicides as become widespread in North America since 2006. The sensitivity of *A. rabiei* to penthiopryad, an efficacious new succinate dehydrogenase inhibitor (SDHI) fungicide not yet in commercial use, was assessed using 50 isolates collected in 2008 in Saskatchewan, Canada. The effective concentration to inhibit mycelium growth by 50% (EC_{50}) was estimated for each isolate using a radial growth assay on PDA amended with technical grade penthiopryad at 0.01, 0.1, and 1 µg mL^{-1} with three replicates per treatment. EC_{50} values ranged from 0.002 to 0.30 µg mL^{-1} with a mean of 0.10 µg mL^{-1}. A discriminatory dose of 0.3 µg mL^{-1} was selected for assessment of 32 additional isolates collected in 2008 and 47 isolates collected in 2009 (never exposed to penthiopryad); 12 of the 79 isolates exhibited < 50% growth inhibition. This study will provide the basis for monitoring sensitivity in *A. rabiei* populations to this new fungicide. Also, cross-resistance between penthiopyrad and boscalid (a SDHI used for blight management on chickpea) is being assessed.

Evaluation of Brassica germplasm for resistance to clubroot of canola. G. Peng, K.C. Falk, B. James, and R.K. Gugel. *Agriculture and Agri-Food Canada, 107 Science Place, Saskatoon, SK, S7N 0X2 Canada*

Clubroot, caused by the protist pathogen *Plasmodiophora brassicae* Woronin, is a serious disease of Brassica crops worldwide and is becoming a serious threat to canola production on the Canadian prairies. The disease was first observed on canola in the Edmonton area in 2003, but has since been found in more than 450 fields in Alberta. Contaminated fields have also been reported in Saskatchewan and Manitoba. Since 2009, clubroot resistant canola cultivars have been available to producers, but the durability of these cultivars is unknown. Clubroot resistance genes are generally race specific and therefore it is important to establish a broad base of genetic resistance for the development of new cultivars over the long term. In the current study, over 900 accessions of *Brassica spp*. have been evaluated against the predominant *P. brassicae* race (pathotype 3) using a new bioassay system. Ten accessions, mostly from several sub-species of *B. rapa* and *B. juncea*, showed good resistance, reducing clubroot severity by 70–100% relative to susceptible controls. These resistance materials are being further characterized.

Plant defense and drought tolerance genes interaction in triticale (x*Triticosecale* Wittm.) seedlings during osmotic stress. C. Badea, M. Frick, Y. Xu, O. Zabaneh, A. Comeau, R, Weselake and A. Laroche. *Agriculture and Agri-Food Canada, Research Centre, 5403 1st Avenue South, Lethbridge, AB, T1J 4B1 Canada; (A.C.) Agriculture and Agri-Food Canada, Research Centre, Quebec City, QC, G1V 2J3 Canada; and (R.W.) Department of Agriculture, Food and Nutritional Science, University of Alberta, Edmonton, AB, T6G 2P5 Canada*

Stress is a common factor during a plant's growth and development due to its sessile state. Studies have shown that most plants respond to stress in a similar two-step manner. The initial step is a cellular protection mechanism directing an increase in molecules such as cytoplasmic calcium followed by a graduate increase in reactive oxygen species (ROS). The second step is the apparition of different stimuli or signals to induce a gene regulation response to minimize the impact of the specific stress. Some of the components within these pathways during the first response step amongst different abiotic and biotic stresses are common. Moreover, the existence of a core of plant stress response genes, named PCESR (plant core environmental stress response proteins) has been previously suggested. After transcriptome analysis of triticale seedlings under osmotic drought stress using next generation sequencing (NGS) technology, we have identified more than 5000 differentially expressed genes involved not only in drought, as expected, but also many other stresses such as cold, salinity as well as response to pathogens. Our data analyses reveal a collection of genes in the plant response to abiotic and biotic stresses and further confirm results found in similar studies in different plant species.

Efficacy of boron formulations against primary infection of *Plasmodiophora brassicae* in Shanghai pak choy. A. Deora, B.D. Gossen and M.R. McDonald. *Agriculture and Agri Food Canada, 107 Science Place, Saskatoon, SK, S7N 0X2 Canada; and (M.R.M) Department of Plant Agriculture, University of Guelph, Guelph, ON, N1G 2W1 Canada*

Plasmodiophora brassicae Woronin, a soil-borne protist, causes clubroot disease of many crops in the Brassicaceae. Application of boron (B) suppresses the development of clubroot in root hairs. The present study was conducted to assess the impact of commercial formulations and concentrations of B under controlled conditions. Three products were assessed: Boron (H_3BO_3; 10% B, liquid; Alpine Plant Foods Corporation), BoronMax (boron complexed with plant carbohydrates, 8.1% B, liquid; NutriAg) and Solubor ($Na_2B_8O_{13}4H_20$; 20.5%, powder; U.S. Borax Inc.) as a drench to sand growth medium immediately after planting seeds of Shanghai pak choy cv. Mei Qing Choi (*Brassica rapa* subsp. *Chinensis* (Rupr.) var. *communis* Tsen and Lee). The products were applied at concentrations equivalent to 0, 0.25, 0.5, 1, 2, 4, 8, 16 and 32 kg ha^{-1}. The experiment was designed as a factorial randomized complete block design with four replicates and three plants per experimental unit. Phytotoxicity was observed for each formulation at rates >2 kg ha^{-1}; germination was inhibited by about 10, 20, 40, and 60% at 4, 8, 16 and 32 kg ha^{-1}, respectively. Solubor was the most effective formulation and the most effective non-phytotoxic rate for all of the formulations was 2 kg. At 2 kg, Solubor reduced primary infection relative to the nontreated control (from 59% of root hairs to 45%), and inhibited development of the pathogen, reducing the proportion of infected root hairs with zoosporangia from 45% to 16% and dehisced zoosporangia from 24% to 5%. Further studies on timing of application are underway.

Contributed Poster Session 2

Overwintering *Puccinia striiformis* in central Alberta. K. Kumar, K. Xi¸ M. Holtz, K. Turkington and D. Salmon. *Field Crop Development Centre, Alberta Agriculture and Rural Development, 6000 C and E Trial, Lacombe, AB, T4L 1W1 Canada; (K.T.)Agriculture and Agri-Food Canada, Lacombe Research Centre, 6000 C and E Trial, Lacombe, AB, T4L 1W1 Canada; and (D.S.)Field Crop Development Centre, Alberta Agriculture and Rural Development, 5030-50 St. Lacombe, AB, T4L 1W8 Canada*

Viable inoculum of *Puccinia striiformis* Westend was demonstrated for the first time to overwinter on winter wheat in central Alberta. Stripe rust pustules were observed in winter wheat field plots at Lacombe until the middle of March and urediniospores sampled were able to germinate in the laboratory. The polymerase chain reaction (PCR) method detected infection in leaf samples collected from January to May in 2010 from plants artificially inoculated the previous year. Snow cover appeared to be critical for inoculum to overwinter under central Alberta conditions. In separate experiments, significantly higher stripe rust severity was observed in spring wheat and barley seeded adjacent to winter wheat fields than spring seeded wheat fields in all four growing seasons during 2007-2010. When sampled in June and July, 2009, more frequent latent infections were detected in wheat and barley seeded in close proximity to winter wheat than those seeded close to spring wheat using PCR. The present study demonstrates that overwintering inoculum on living hosts, known as a green bridge, may play a role in the earlier onset of stripe rust. Spring wheat and barley seeded adjacent to winter wheat fields may result in more severe stripe rust at the end of the season vs. spring crops seeded near spring wheat fields.

Adaptation of *Puccinia striiformis* f. sp. *tritici* and f. sp. *hordei* to different temperatures. M.D. Holtz, K. Kumar, and K. Xi. *Field Crop Development Centre, Alberta Agriculture and Rural Development, 6000 C and E Trail, Lacombe, AB, T4L 1W1 Canada*

Stripe rust caused by *Puccinia striiformis* is a threat to wheat and barley production in Alberta. Strains of *P. striiformis* f. sp. *tritici* that are better adapted to warmer temperatures have been reported spreading throughout the U.S.A. The ability of *P. striiformis* f. sp. *tritici* (Pst) and f. sp *hordei* (Psh) infections to progress at both low (15°C) and high (23°C) temperatures was determined *in vivo*, after an initial 24hr 12°C incubation period. After 18 days both *formae speciales* showed significantly reduced latent periods at 23°C, but only in Pst did this not cause significantly reduced stripe rust severity and sporulation 18 days after inoculation. Infection success was decreased dramatically for both formae speciales at higher temperatures without the initial 24 hr 12°C incubation. Preliminary laboratory tests showed a consistent inhibition of the germination of Psh's urediniospores on water agar at higher temperatures that did not occur with Pst's. The results suggest that Pst is better adapted than Psh to warmer Albertan summers, but cool conditions are still necessary for the initiation of disease development by both *formae speciales*.

Control of clubroot (*Plasmodiophora brassicae*) with microbial and synthetic fungicides. G. Peng, R. Lahlali, S.F. Hwang, M.R. McDonald, B.D. Gossen, R.H. Hynes, and S.M. Boyetchko. *Agriculture and Agri-Food Canada, Saskatoon Research Center, Saskatoon, SK, S7N 0X2 Canada; (S.F.H.) Alberta Agriculture and Rural Development, Crop Diversification Centre North, Edmonton, AB, T5Y 6H3 Canada; and (M.R.M.) University of Guelph, Department of Plant Agriculture, Guelph, ON, N1G 2W1 Canada*

Clubroot is an emerging threat to canola (*Brassica napus*) production in western Canada and a serious problem on Brassica vegetable crops worldwide. In inoculated trials on canola under controlled-environment conditions, commercial formulations of the biofungicides Serenade® (*Bacillus subtilis*) and Prestop® (*Gliocladium catenulatum*), and the synthetic fungicides fluazinam and cyazofamid reduced clubroot severity substantially when applied as a soil drench at 1.4 Kg, 10 L, 2.9 L, and 0.54 L/ha, respectively. Suspensions of the biofungicides made with pure bacterial or fungal cultures and cell-free product filtrates were less effective. These fungicides were also evaluated as in-furrow treatment at the same rates as above in two field trials on canola in Alberta, and one napa cabbage (*B. rapa* subsp. *Chinensis* var. *utilis*) trial in Ontario in 2009. Resistant and susceptible cultivars were included in each trial. Plants (20-25 per rep) were assessed for clubroot severity at bloom of canola or 8 wks after seeding of napa cabbage. Severe spring drought conditions in Alberta delayed the germination of canola, and none of the products reduced clubroot substantially. A further study showed that most of the products had substantially diminished efficacy after staying in dry soils for over three weeks. For the napa cabbage trial, a rain event occurred 2 days after seeding. All the fungicides reduced clubroot severity on the susceptible cultivar, with efficacy ranging from 54 to 84%. Resistant cultivars reduced clubroot severity by 87–93% on canola and 99% on napa cabbage when compared to susceptible cultivars.

New races of sunflower downy mildew. K.Y. Rashid. *Morden Rresearch Station, Agriculture and Agri-Food Canada, Morden, MB, R6M 1Y5 Canada*

Downy mildew, caused by the fungus *Plasmopara halstedii* (Farl.) Berl. and de Toni, is a widespread disease globally affecting sunflower (*Helianthus annuus* L.). It is soil- and seed-borne and can survive for several years in the soil. Favorable conditions for epidemics include abundant soil moisture and temperature of ~17^{o}C at the seedling stage. The presence of this disease in Manitoba varies annually (20-80% of crops) with trace to 30% infected plants Yield loss is directly proportional to % infected plants. The virulence of isolates collected from Manitoba during 2005-2010 was assessed on nine differential sunflower genotypes under controlled conditions. Race 700, 710, 720, 730 and 770, and races 300 320, and 330 are predominant. Races in the 700 group are more virulent on sunflower and present at higher frequency than the races in the 300 group. Races 100, 200, 400, 500 and 600 are present at low frequency. Most commercial sunflower hybrids express various levels of resistant to races 100 and 500 but are susceptible to race-groups 300 and 700. In addition to the appearance of the new races of downy mildew in Manitoba, 50-80% of the isolates from different years have shown resistance to the Metalaxyl (apron) seed treatment.

Transcript profiling of genes upregulated in the *Ruh1* incompatible interaction in Hannchen barley inoculated with *Ustilago hordei*, the covered smut pathogen. Y. Wang, D.A. Gaudet, C. Penniket, M. Frick, Z-X. Lu, G. Bakkeren and A. Laroche. *Agriculture and Agri-Foods Canada Research Center, 5403 1st Avenue South, Lethbridge, Alberta, T1J 4B1 Canada; and (G.B.)Agriculture and Agri-Foods Canada Research Center, 4200 Hwy 97, Summerland, BC, V0H 1Z0 Canada*

Barley (*Hordeum vulgare*), wheat (*Triticum aestivum*) and seed-borne barley smut pathogen (*Ustilago hordei*) provide an ideal system for comparing molecular mechanisms involved in the host-compatible, -incompatible, and non-host interactions. We used the Affymetrix GeneChip® Wheat Genome Array to compare transcriptional changes occurring on the coleoptiles of two barley cultivars in a compatible interaction with *U. hordei*, an incompatible reaction conferred by the resistance gene *Ruh1*, and in the non-host wheat cultivar. The altered transcript profiles of plants suggested that multiple pathways are reprogrammed in response to *U. hordei* inoculation. For non-host interactions, the jasmonic acid (JA) pathway was preferentially early-upregulated after 48 h whereas for host compatible and *Ruh1* interactions, both salicylic acid (SA) and JA pathways were upregulated but expression levels were late upregulated in Hannchen at 72 h to 144 h. qRT-PCR profiling revealed specific early upregulation of some *PR*-, signal transduction related- and plant defense-genes in Hannchen at 29h to 48h. Application of methyl jasmonate (MeJA), SA, and ethylene to leaves revealed that only *PR1.1* was strongly upregulated by all 3 compounds in both barley and wheat, and the majority of the defence-related genes are only slightly upregulated by these signalling compounds. SA and JA may be the key signaling molecules that activate defense responses against *U. hordei* in barley.

Production of non-specific esterase by conidia of *Peronospora viciae* f. sp. *pisi*. J. Feng, K.F. Chang, S.F. Hwang, S.E. Strelkov, B.D. Gossen, R.L. Conner and D.L. McLaren. *Crop Diversification Centre North, Alberta Agriculture and Rural Development (AARD), Edmonton, AB, T5Y 6H3 Canada; (K.F.C.) Crop Development Centre, AARD, Lacombe, AB, T4L 1W1 Canada; (S.E.S.) Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, AB T6G 2P5, Canada; (B.D.G) Agriculture and Agri-Food Canada (AAFC), Saskatoon, SK, S7N 0X2 Canada; (R.L.C.) AAFC, Morden, MB, R6M 1Y5, Canada; and (D.L.M.) AAFC, Brandon, MB, R7A 5Y3 Canada*

Esterase activity secreted by conidia of pea downy mildew fungus, *Peronospora viciae* f. sp. *pisi* was assayed using indoxyl acetate hydrolysis, which generates indigo blue crystals. When conidia were incubated on artificial media in the presence of indoxyl acetate, blue crystals were observed around the conidia. In contrast, no such crystals were produced on the conidia after surface washing by washing buffer, indicating that the esterase activity was extracellular or weakly bound to the conidia surface. Activity of these esterases was inhibited by diisopropyl fluorophosphate, which is selective for serine esterases. Theses observations indicate that *Peronospora viciae* f. sp. *pisi* can produce extracellular serine esterases during conidia germination. The importance of these serine esterases for the fungal pathogenicity is under investigation.

Effect of temperature on clubroot (*Plasmodiophora brassicae*) symptom initiation on Shanghai pak choy. K. Sharma, B.D. Gossen, M.R. McDonald. *University of Kassel, Witzenhausen, Germany; (B.D.G.) Agriculture and Agri-Food Canada, Saskatoon Research Centre, Saskatoon, SK, S7N 0X2 Canada; and (M.R.M.) Department of Plant Agriculture, University of Guelph, Guelph, ON, N1G 2W1 Canada*

Clubroot, caused by *Plasmodiophora brassicae* Woronin, is an important disease of Brassica crops worldwide. Studies were conducted to assess the effect of temperature on initiation of visible clubroot symptoms on Shanghai pak choy (*Brassica rapa* L. subsp. *Chinensis* (Rupr.) var. *communis* Tsen and Lee). Three-day-old seedlings were transplanted into small plastic pots (root-trainers) containing soil-less growing media, kept at 20ºC for 1 wk, and inoculated by pipetting 600 µL of resting spore suspension (10^8 spores of *P. brassicae* /mL) onto the base of each seedling. After inoculation, the seedlings were transferred to growth cabinets at 10, 15, 20, 25 and 30ºC (14-h photoperiod, 65% RH). Each day from 8 to 36 days after inoculation (DAI), the roots of 12 plants per treatment were collected, washed, and assessed for symptom development. No symptoms were observed at 36 DAI in plants kept at 10ºC. Swelling of the tap root was visible at 28 DAI in plants at 15 ºC, 14 DAI at 20º and 30ºC, and 10 DAI at 25ºC. This result supports the results from companion studies, including field trials, that cool temperatures result in slower symptom development of clubroot in Brassica crops. Sectioning and staining to assess the impact of temperature on each stage of the pathogen's life cycle are in progress.

Reaction to *Plasmodiophora brassicae* pathotype 6 in lines of *Brassica* species. K.C. Kalpana, M.R. McDonald, and B.D. Gossen. *Department of Plant Agriculture, University of Guelph, Guelph, ON, N1G 2W1 Canada; and (B.D.G.) Agriculture and Agri-Food Canada, Saskatoon Research Centre, Saskatoon, SK, S7N 0X2 Canada*

Clubroot of *Brassica* spp., caused by *Plasmodiophora brassicae* Woronin, is an important disease of vegetable Brassica crops worldwide, and has spread rapidly on canola (*B. napus* L.) in western Canada since first reported in 2003. Trials to evaluate clubroot incidence and severity on lines of selected *Brassica* spp. were established on naturally infested organic soil (pH 6.7) in 2008 and 2009 near Bradford, Ont. Pathoptype 6 is predominant at this site. The study focused on the Rapid Cycling Brassica Collection (RCBC), including lines of *B. carinata*, *B. juncea, B. napus*, *B. nigra, B. oleracea*, *B. rapa,* and *Raphanus sativum*), which have potential as model systems for controlled environment studies and as differential hosts in pathotype assessment, but also included lines of canola and Asian vegetables (*B. rapa*) such as pak choy (var. *communis*), Chinese flowering cabbage (var. *utilis*) and napa cabbage (ssp. *Pekinensis*). Clubroot incidence and severity were higher in 2008 than in 2009, but the pattern of response was similar each year. Several of the RCBC lines were susceptible to pathotype 6, as were all of the Asian vegetables. RCBC lines of *B. carinata* and *B. juncea*, as well as pak choy and flowering cabbage, are good candidates for use as model crops. The susceptible canola lines will be useful for studies with pathotype 6, such as studies of fungicides and symptom development. Canola lines 5202 LL and 04- 2 and napa cabbage Deneko had no symptoms of clubroot.

Phytoplasma research: a bridge between plant pathology and entomology. C.Y Olivier. *AAFC-Saskatoon Research Centre, 107, Science Place, Saskatoon, SK, S7N 0X2 Canada*

Phytoplasmas are bacteria-like pathogens that cause hundreds of diseases worldwide, in hundreds of plant species, some of them being economically important. Phytoplasma diseases cause yield and quality reduction as well as poor plant growth. No resistance has been identified but tolerance and recovery phenomenon have been observed in several plant species. Phytoplasmas are a very unique group of pathogens because they inhabit two very different environments. They live and reproduce in the plant phloem and in most of the organs of their insect vectors. Phytoplasmas manipulate plant and vector metabolism to promote their propagation and spread. In plants, phytoplasmas express specific factors that directly disrupt host plant gene expression in order to by-pass plant defense responses. In vectors, phytoplasma transmission seems to rely on specific recognition mechanisms between insect gut proteins and phytoplasma membrane proteins. Overall, very little is known about those pathogenicity mechanisms. Phytoplasma disease control relies mostly on the chemical control of the vector population. Therefore, a large body of research has addressed vector identification and epidemiology in order to develop efficient and sustainable integrated pest control approaches. Recently, research on symbionts has opened the possibility of developing new control methods.

Development of soil bacteria for biological control of green foxtail. S.M. Boyetchko and R.K. Hynes. *Agriculture and Agri-Food Canada, Saskatoon Research Centre, Saskatoon, SK, S7N 0X2 Canada*

The application of microorganisms for biological weed control (i.e. bioherbicides) has been a worldwide initiative for several decades. In 1991, research at Agriculture and Agri-Food Canada (AAFC) was initiated to develop bacteria as bioherbicides against green foxtail. Discovery began with *in vitro* testing using a laboratory bioassay of hundreds of bacterial strains and continued with plant growth pouch bioassays, ultimately leading to the selection of three bacterial strains. These bacteria showed broad-spectrum activity against other grass weed species and their ability to control herbicide-resistant wild oat and green foxtail populations confirmed that their modes of action differed from existing chemical herbicides. *Pseudomonas fluorescens* strain BRG100 was selected for detailed assessment and development as a bioherbicide, with the aim of registering and commercializing it. Optimization of fermentation parameters investigating nutritional factors that promote i) bacterial cell production and ii) efficacy has been conducted. Pre-emergent soil application of BRG100 when formulated into a pesta granule resulted in significant reductions in green foxtail growth in the field. Several improvements to the pesta formulation have been made in order to preserve and extend shelf life beyond one year. Current and future research is focusing on formulation improvements, application and delivery, and development of molecular markers for environmental risk assessment.

What's going on inside wheat stems? The interactions between pathogens and a nefarious herbivore. D.K. Weaver, Z. Sun, A. Wenda-Piesik, W.E. Grey, A.T. Dyer and W.L. Morrill. *Department of Land Resources and Environmental Sciences, Montana State University, Bozeman, MT 59717 USA; (Z.S., W.E.G., A.T.D.) Department of Plant Sciences and Plant Pathology, Montana State University, Bozeman, MT 59717 USA; and (A.W-P.)Department of Agronomy and Biostatistics, University of Technology and Life Science, ul. Kordeckiego 20E, 85-225 Bydgoszcz, Poland*

The *Fusarium* crown rot complex and the wheat stem sawfly are co-occurring pests of wheat grown in the Northern Great Plains of North America. Each causes multimillion dollar losses in this key crop. The pathogenicity of single isolates of three *Fusarium* spp., *F. pseudograminearum*, *F. culmorum*, and *F. acuminatum*, obtained from colonized larval cadavers of wheat stem sawfly, was evaluated for sawfly larvae developing within growing spring and winter wheat plants in field experiments. All tested *Fusarium* isolates caused lethal effects in developing larvae inside stems under natural conditions, and could produce up to eighty percent larval mortality. The *F. pseudograminearum* and *F. culmorum* isolates caused greater larval mortality than the *F. acuminatum* isolate. The *Fusarium* isolates also produced disease symptoms in both spring and winter wheat plants, which included an increase in disease severity, a reduction in plant density, and yield loss. There were strong positive correlations between larval mortality and disease severity, which reflected the interchangeability of the *Fusarium* isolates between entomopathogenicity to sawfly larvae and phytopathogenicity to wheat plants. As widespread plant pathogens, *Fusarium* spp. are also causing endemic annual mortality in sawfly larval populations in growing spring and winter wheat fields.

Plant Pathology Society of Alberta
31th Annual Business Meeting
Lethbridge, AB
14 October 2010

Minutes

Present:

André Laroche	**Michele Frick**	**Thérèse Despins**
Khalid Rashid	**Ron Howard**	**Denis Gaudet**
Noryne Rauhala	**Julie Sisson**	**Gerald Martens**
Ralph Lange	**George Turnbull**	**Gary Peng**
Kan-Fa Chang	**Sheau-Fang Hwang**	**Bruce Gossen**
Byron Puchalski		

1. Adoption of Agenda

Motion to accept: Thérèse Despins, Ralph Lange. Carried.

2. Adoption of Minutes of the Annual Meeting 2009 with correction of minor typographical errors

Motion to accept: Denis Gaudet, Sheau-Fang Hwang. Carried.

3. Financial Report – Noryne Rauhala

Every year, the annual meeting has been making a profit and the bank balance is growing. There is $2948.35 in the chequing account at present, plus GIC investments of $6000.00 and $4000.00. Volunteers were requested for a committee on the investments to bring suggestions to the AGM in 2011. Noryne Rauhala (chair), Byron Puchalski and Michele Frick volunteered.

Motion to accept: Noryne Rauhala, Bruce Gossen. Carried.

4. Disease Survey Committee – Kelly Turkington - No report.

Ralph Lange reported on the 2010 Canola Disease Survey. An extensive survey of canola diseases in western Canada stems from a trade dispute with China concerning blackleg. 143 fields were surveyed for major and minor diseases. Standard methods were employed, 100 plants per field. Samples were sent to CFIA for diagnosis of blackleg. Based on symptoms, blackleg was present in 49% of crops in AB with a mean incidence of 9%. The highest severity and worst mean incidence was in region 4A (eastern border of AB), while the lowest severity was in region 2 (Lethbridge area) and the lowest mean incidence was in region 7 (Peace area). Blackleg stem lesions were present in 50% of canola in AB. Sclerotinia was present in 64% of fields surveyed with a mean incidence of 15% and mean severity of 2, province wide. The highest severity and worst incidence was in region 4A, while the lowest severity was in region 7

and the lowest mean incidence was in region 2. Fusarium wilt was found in 3.5% of canola crops. None was expected due to resistant varieties. Brown girdling root rot was found in 25% of canola crops, 33% in region 7. This is the largest survey is several years and will continue for 3 years.

Byron Puchalski surveyed cereal diseases in southern Alberta from mid-May to mid-July. Tan spot was the number 1 cereal pathogen this year, present in 75-85 % of fields. The severity was quite high on susceptible varieties such as Radiant with severity reaching 70% of leaf surface area. Severity reached 60% of flag leaf surfaces in susceptible hard red varieties and 40% for susceptible durum wheats. Triticale was also infected but severity rarely exceeded 20%. Stripe rust pustules were first evident in the last week of June. Spring wheat fields near Seven Persons had an incidence of 80% and a flag leaf severity of 25%. Severity levels of 30% in Radiant, suggests *Yr10* resistance has been defeated. Late seeded stripe rust susceptible spring wheat was heavily damaged with infection levels of 70-80%. Powdery mildew was confined to the lower canopy. There was less FHB and Ergot than in 2009.

Therese Despins reported that flooding prevented good bunt infection.

Ron Howard reported 5 other surveys in AB.

1. A provincial FHB survey in cereal and corn will be completed in fall 2010. They surveyed 700 fields, determining the proportion of grains (head at late dough) and stubble infected with *Fusarium graminearum*. *F.graminearum* positive samples were sent for chemotyping.
2. Strawberry survey as per Ron Howard's paper.
3. Clubroot survey of stubble by municipalities, University of Alberta, Alberta Agriculture and AAFC. Results are not yet available.
4. Dry bean disease of Alberta and Ontario. White mould, bacterial blight and root rot were found.
5. Potato survey for late blight is not complete. Storage losses due to *Fusarium sambucinum* and *F. coeruleum* were reported. There was an outbreak of late blight in central to Southern Alberta.

Ron also reported internal fruit rot in greenhouse peppers caused by *Fusarium* with some mycotoxin production.

5. Historical Committee Report – Denis Gaudet

The archives of the PPSA are held at University of Alberta, C/O Dr. J.P. Tewari. Past Presidents and other officers of the PPSA should submit important records such as PPSA Minutes, meeting programs, etc., to be stored in the archive when they complete their term of office, or as possible during their term. Plant Pathology in Canada has gone to the publisher, Houghton Boston from Saskatoon, with an expected publication date of approximately 6 weeks. The price will be $75 with freight of approximately $15. Denis acknowledged the excellent editorial work of Richard Gugel. Denis handed around a prepublication copy for viewing.

6. Terry Swanson Scholarship - Ron Howard

A written report was handed out. Daily interested Savings Account balance is $405.64, GIC balance of $11,873.74 was invested for a 16 month term at 2.25%. There was no nomination for the award from the University of British Columbia in 2009. The 2010 Dr. Terry Swanson Memorial Scholarship will be awarded to a student at the University of California Riverside. **Motion to accept**: Ron Howard, Noryne Rauhala. Carried.

There was discussion regarding renaming the Terry Swanson Scholarship to the Swanson Award for Plant Pathology and Nematology. Comments were positive. There was a motion that the Swanson Award for Plant Pathology and Nematology be the new name for the Terry Swanson Scholarship.
Motion to Accept: Ron Howard, Noryne Rauhala. Carried unanimously**.**

7. The Alberta Graduate Student Scholarship Award – Denis Gaudet

No names have been forwarded yet for the 2010 award. The terms of reference state that candidates for the award must be nominated by a member in good standing of the Plant Pathology Society of Alberta. Concern was expressed because there are no members of PPSA at the University of Lethbridge or University of Calgary. There was a motion to eliminate this clause from the terms of reference and to include PPSA membership for 3 years with the award.
Motion to Accept: Denis Gaudet, Noryne Rauhala. Carried.
Denis Gaudet, Ron Howard and Steve Strelkov will work hard to get applicants for the Award.

8. Honorary Life Members

No nominations for this year. Ralph Lange volunteered to update the list of current Honorary Life Members for next year.

9. CPS Report – Khalid Rashad.

The CPS 2010 annual meeting was held at UBC in Vancouver, BC with the Pacific Northwest division of the American Phytopathological Society. It was an excellent meeting. The 2011 meeting of the CPS will be held jointly with Plant Canada in Halifax, NS tentatively from July 17-21, 2011. Khalid reminded members that membership notices for CPS will go out in November and he encouraged members of PPSA to join CPS as well. He also acknowledged the contribution of CPS to continue to support PPSA. Denis announced that the Award for Outstanding Research was granted to Bruce Gossen at the 2010 meeting.

10. Future Meetings

b) 2011 - Edmonton
c) 2012 – Lloydminster

11. Election of Officers

Nominations from the floor were as follows:
Sheau-Fang Hwang – President
Steve Strelkov – Secretary
Bruce Gossen – Vice-President
Noryne Rauhala - Treasurer
Directors: Michael Harding, Ralph Lange, Robyne Bowness
Motion to accept: Ron Howard, Denis Gaudet. Carried.

13. Other Business

Thanks to the local arrangements committee: André Laroche, Michele Frick, Denis Gaudet and Byron Puchalski

Thanks to the sponsors of the joint meeting with WFPM and ESA: BASF Canada, Syngenta Crop Protection Canada, E.I DuPont Canada Company, Association of Alberta Agricultural Fieldmen, SeCan, Viterra Alberta Bean Division, Dow AgroSciences Canada Inc., Alberta Pulse Growers, Bayer CropScience, 20/20 Seed Labs Inc, BioVision Seed Labs, Potato Growers of Alberta, Canadian Phytopathological Society, Fisher Scientific and Cargill.

14. Adjournment

Moved: Bruce Gossen