Canadian Society for Horticultural Science

National Conference October 4 - 6, 2018

Marriott on the Falls Hotel

https://www.marriottonthefalls.com/

Niagara Falls, Canada

http://cshs.ca/

Image taken from Marriott on the Falls by K. Tanino

STUDENT AWARDS!

- **Cannabis Symposium**
- **Fruit Symposium**
  (Tree Fruit, Small Fruit and Viticulture)
- **Vegetable Symposium**
- **Postharvest Storage, Processing and Nutraceutical Symposium**
- ***Haskap Workshop***

https://agbio.usask.ca/cshs2018/

Many thanks and appreciation to our Gold, Silver and Bronze Sponsors, Friends of the CSHS sponsors, the Conference Committee and the Canadian Society for Horticultural Science (CSHS) Executive (Karen Tanino, Valerie Gravel, Diane Edwards, Bourlaye Fofana, Samir Debnath, Simone Castellarin, Kate Congreves (Prairie Rep), Youbin Zheng, David Wees (Eastern Rep), David McKenzie (Atlantic Rep) and Elena Benic). Additional thanks to Gloria Gingera, Kaila Hamilton, Sara Stricker, Sarah Drury, Ian Willick, Eric Rae, Kathryn Carter, Christoph Kessel, Laura Dowling, M.P.M. Nair, Abidur Rahman, Gowribai Valsala, Perumal Vijayan, Sean Westerveld, Wendy Mathieu, Stacy Blacquiere, Véronic Gagné, Josh Crockett, Richard Grimstead, Kirk Lewis, Jerry Nanda and Shirley Maruk.

CONFERENCE ORGANIZING COMMITTEE

Karen Tanino, ***Conference Chair***	*CSHS President*. Professor, Department Plant Sciences, University of Saskatchewan.	karen.tanino@usask.ca
Valérie Gravel, ***Student Presentation Judges Chair***	*CSHS Vice-President*. Assistant Professor, Department of Plant Science, McGill University.	valerie.gravel@mcgill.ca
Bourlaye Fofana	*CSHS secretary*. Research Scientist, Agriculture and Agri-Food Canada (AAFC), Charlottetown, P.E.I.	bourlaye.fofana@agr.gc.ca
Diane Edwards	*CSHS Treasurer*. ABI Environmental Services Ltd., Calgary AB.	edwardsd@ucalgary.ca
Simone Castellarin	*CSHS Western representative*. Associate Professor, Faculty of Land and Food Systems, University of British Columbia.	simone.castellarin@ubc.ca
Elena Benic	*CSHS student representative*. Department of Plant Sciences, University of Saskatchewan.	elena.benic@usask.ca
Darby McGrath	Vineland Research and Innovation Centre (VRIC), Vineland, ON.	Darby.Mcgrath@vinelandresearch.com
Rita Weerdenburg	Canadian Ornamental Alliance, ON.	rita@canadanursery.com
Deanna Nemeth, ***Tour and AV coordinator***	Horticulture Sustainability Specialist, OMAFRA	deanna.nemeth@ontario.ca;
Theo Blom, ***Tour Coordinator***	Professor Emeritus, Department of Plant Agriculture, University of Guelph.	tblom@uoguelph.ca;
Stephanie Vickers, ***Tour Coordinator***	Junior Land Resource Specialist – Soil Intern, Resource Information and Business Services, Environmental Management Branch, OMAFRA.	Stephanie.Vickers@ontario.ca;
Bob Bors, ***Haskap Workshop***	Head of the Fruit Science program, Department of Plant Sciences, University of Saskatchewan.	bob.bors@usask.ca
Mary Ruth McDonald, ***Vegetable Symposium Co-Chair***	Professor, Department of Plant Agriculture, University of Guelph.	mrmcdona@uoguelph.ca;
Elaine Roddy, ***Vegetable Symposium Co-Chair***	Vegetable Crops Specialist, OMAFRA, Ridgetown, ON.	elaine.roddy@ontario.ca;
Youbin Zheng, ***Cannabis Symposium Chair***	*CSHS Central Representative*. Associate Professor, School of Environmental Sciences, University of Guelph.	yzheng@uoguelph.ca
Jayasankar Subramanian, ***Fruit Symposium Chair, Tree Fruit Co-Chair***	Professor, Department of Plant Agriculture, University of Guelph.	jsubrama@uoguelph.ca
Samir Debnath, ***Small Fruit Co-Chair***	*CSHS Past President*. Research Scientist, AAFC, Newfoundland and Labrador.	samir.debnath@agr.gc.ca
Alan Sullivan, ***Tree Fruit Co-Chair***	Professor, Department of Plant Agriculture, University of Guelph.	asulliva@uoguelph.ca
Andrew Reynolds, ***Viticulture Co-Chair***	Professor of Viticulture & Plant Physiology Cool Climate Oenology & Viticulture Institute, Brock University.	areynolds@brocku.ca
Gale Bozzo, ***Postharvest Storage, Processing and Nutraceuticals Symposium Chair***	Associate Professor, Department of Plant Agriculture, University of Guelph.	gbozzo@uoguelph.ca

CONFERENCE AT A GLANCE

TIME	LOCATION	DESCRIPTION
THURSDAY Oct. 4 (RED Day)	**THURSDAY Oct. 4**	**THURSDAY Oct. 4**
8:00 am sharp (return by 1:00 pm)	Outside of the Marriott on the Falls hotel	Depart on **Pre-Conference tour** Dynasty black executive shuttle bus
10:00 am – 4:00 pm	Lobby, Marriott on the Falls	***Registration Desk Open***
12:00 pm – 5:00 pm	Salon B (3rd floor)	**Poster set up**
1:00 – 4:30 pm (2:45 pm – 3:00 pm break)	Hennepin N-S Ballroom (1st floor)	**Haskap Workshop**
1:00 pm – 5:00 pm (2:45 pm – 3:00 pm break)	Salon A (3rd floor)	**Vegetable Symposium** ***Sponsored by: heliospectra$_{TM}$***
5:00 pm – 7:00 pm	Salon A and Salon B (3rd floor)	**Reception and Poster Session** ***Reception sponsored by Canadian Science Publishing*** ***Registration Desk Open***
7:00 pm – 8:00 pm	Salon A	**Annual General Meeting**
8:00 – 9:00 pm	Salon A	**Graduate Student Event**
FRIDAY Oct. 5 (PURPLE Day)	**FRIDAY Oct. 5**	**FRIDAY Oct. 5**
7:00 am – 8:50 am	Oakes Grand Ballroom South (2nd floor, Mezzanine)	**Sponsor table set up**
7:00 am – 8:50 am	Milestones Restaurant Marriott on the Falls, 2nd floor	Breakfast (vouchers) (for full conference delegates)
7:30 am – 8:50 am	Oakes Grand Ballroom (2nd floor Mezzanine Level)	***Registration Desk Open***
8:50 am – 5:00 pm (10:30 am – 11:00 am break) (12:15 pm – 1:30 pm lunch in Oakes Grand Ballroom North 2nd floor) (2:50 pm – 3:20 pm break)	Oakes Grand Ballroom South (2nd Floor Mezzanine Level)	**Cannabis Symposium** ***Co-sponsored by:*** ***7Acres*** ***Hawthorne Gardening Co***
8:00 am – 9:00 am	Outside of Salon A (3rd floor)	***Registration Desk Open***
8:50 am – 5:00 pm (10:30 am – 11:00 am break) (12:15 pm – 1:30 pm lunch in Oakes Grand Ballroom North 2nd floor) (3:00 pm – 3:30 pm break)	Salon A (3rd floor)	**Fruit Symposium**
5:00 pm – 5:10 pm (depart at 5:10 pm) **6:30 pm Banquet** Wine and Beer Tasting Two departures back to hotel: **9:45 pm and 10:45 pm**	***Load onto two WEGO buses** located on the road outside of hotel and depart. *Return from Benchmark Restaurant to the Marriott hotel.	***Pre-banquet inside tour of the Butterfly Conservatory** ***Banquet at the Benchmark** Restaurant including **Wine and Beer Tasting** ***Return to the hotel**
SATURDAY Oct. 6 (BLUE Day)	**SATURDAY Oct. 6**	**SATURDAY Oct. 6**
7:00 am – 8:50 am	Milestones Restaurant Marriott on the Falls	Breakfast (vouchers) (for full conference delegates)
8:30 am – 8:50 am	Hallway near Hennepin Ballroom	***Registration Desk Open***
8:50 am – 12:30 pm (10:45 am – 11:00 am break)	Hennepin N-S Ballroom	**Postharvest Symposium**
12:30 pm – 12:40 pm	Hennepin N-S Ballroom	**Student Oral, Poster Awards**
12:40 pm	Hennepin N-S Ballroom	**Final Remarks**
12:45 pm	Milestones Restaurant 2nd Floor, Marriott on the Falls hotel	Lunch

Haskap Workshop Agenda

Where: Marriott on the Falls Hotel, Niagara Falls, room: Hennepin Ballroom SouthWhen: Thursday October 4, 1:00 – 4:30 pm
Workshop included in full CSHS* conference fees.
Deadline for registration: September 20.
Register: http://agbio.usask.ca/cshs2018/

Presented by Dr. Bob Bors (U of SK) and others TBA

1:00 Introduction: history, U. of SK. program

1:15 Haskap biology: plant characteristics, genetic diversity, adaptation, variety types, major breeding programs

2:00 Growing Haskap: soils, planting, pruning, training for mechanical harvesting, pollination, pests and diseases

2:45 Break

3:00 Harvesting Haskap: harvester types, primary processing, shelf life

3:20 Using haskap: food products, natural dye, health products

4:00 Grower experiences and experiments

4:30 End of workshop

For more info on haskap visit:

www.fruit.usask.ca

* Canadian Society for Horticultural Science national meeting Oct. 4 – 6, 2018

VEGETABLE SYMPOSIUM

Sponsored by heliospectra™ **THURSDAY OCTOBER 4. Location: SALON A (3rd Floor)**

8:00 AM	1:00 PM	Pre-Conference Tour		
10:00 AM	4:00 PM	REGISTRATION OPEN	LOBBY, Marriott on the Falls	
1:00 PM	1:05 PM	Vegetable Symposium	Opening Remarks	Dr. Mary Ruth McDonald, Ms. Elaine Roddy, co-chairs
1:05 PM	1:45 PM	Speaker 1 - invited	Dr. Cynthia Scott-Dupree	Transferring methods of RNAi evaluation for brown marmorated stink bug, American serpentine feaf minor and pepper weevil for vegetable production.
1:45 PM	2:05 PM	Speaker 2	Mr. Michael Celetti	Timing and effect of drenching fluopyram and abamectin over rows planted with Ditylenchus dipsaci infested garli cloves on yield at harvest.
2:05 PM	2:25 PM	Speaker 3 - invited	Dr Francis Larney	Sugar beet response to rotation and conservation management in a 12-year irrigated study in southern Alberta.
2:25 PM	2:45 PM	Speaker 4	Dr. Mary Ruth McDonald	Phosphorous requirements in an onion and carrot crop rotation over time.
2:45 PM	3:00 PM	Refreshment Break		
3:00 PM	3:15 PM	Speaker 5	Ms. Umbrin Ilyas	Yield response to application of phosphorus and mycorrhizae varies with crop type.
3:15 PM	3:35 PM	Speaker 6	Dr. Amit Dhingra	Understanding the molecular basis of phytonutrient composition differences in organically grown tomatoes.
3:35 PM	3:50 PM	Speaker 7	Ms. Elena Benic	The impact of chloroplast ultrastructure and thylakoid architecture on photosynthetic rates of *Amaranthus blitu* varieties.
3:50 PM	4:10 PM	Speaker 9	Dr. Vipen Sawhney	Male sterility in tomato: Physiology, molecular mechanisms and use in hybrid seed industry.
4:15 PM	5:00 PM	Panel discussion	Mr. Brett Skylar, Ms. Jennifer Thompson, Dr. Laura VanEerd	Turning Data into Decisions.
5:00 PM	7:00 PM	REGISTRATION OPEN	Desk near Salon A	
5:00 PM	7:00 PM	POSTER SESSION and RECEPTION		Salon B (bar) and Salon A (food)
7:00 PM	8:00 PM	AGM		Salon A

Invited Oral – Abstract #3

Utilization of RNAi and Sterile Insect Technique for Management of Insect Pests in Vegetable Production Systems

Cynthia Scott-Dupree*[1]

[1]School of Environmental Sciences, University of Guelph, Guelph, ON N1G 2W1.

cscottdu@uoguelph.ca

As the world's population continues to increase at a staggering rate there is an ever increasing demand on the agricultural sector to develop novel production and pest management technologies to be meet consumer expectations. In the past, many of the challenges faced with insect pests was effectively dealt with using chemical controls (pesticides), but it seems that the spectrum of invasive insect pests now present in Canada are not impacted by the insecticides we have registered for them. Novel approaches to insect pest management are urgently needed. RNA interference (RNAi) is a gene silencing mechanism triggered by a double-stranded RNA (dsRNA), and when it is ingested by insect pests it can be immediately lethal or result in decreased viability. Since its discovery as a potential insect control in 2007, the technology has been extended to a large number of insects from various orders. I will discuss the potential of RNAi as a management tool for the brown marmorated stink bug, an invasive insect pest now found in Canada. Although not as novel as RNAi, sterile insect technique (SIT) is experiencing a renaissance as a pest management tactic. It works by introducing sterility as a result of ionizing radiation, into the males of a pest population resulting in a rapid reduction of pest numbers and often eradication within a geographically isolated or confined area. I will discuss the potential of utilizing SIT to manage pepper weevil, another difficult to manage invasive insect pest found in Canada, in vegetable greenhouse production systems.

NOTES

Oral – Abstract #120

Timing and effect of drenching fluopyram and abamectin over rows planted with *Ditylenchus dipsaci* infested garlic cloves on yield at harvest

Michael J. Celetti*[1] and T.J. Cranmer[1]

[1]Ontario Ministry of Agriculture, Food and Rural Affairs, Guelph Ontario.

michael.celetti@ontario.ca

Timing and effect of drenching fluopyram and abamectin over rows planted with *Ditylenchus dipsaci* infested garlic cloves on yield at harvest. Bulb nematode (*Ditylenchus dipsaci*) is a difficult pest to manage in garlic. The effect of drenching a solution of fluopyram (250 grams active/ha), abamectin (22.7 grams active/ha (ABA formulation) (ABA)), abamectin (22.7 grams active/ha (soluble concentration) (SC)) or water over plots of garlic cloves cv. Music infested with *D. dipsaci* (832 nematodes/g dried clove) planted in open furrows in the fall of 2016 prior to closing the furrows, the following spring (2017) on top of the rows or both fall (2016) and spring (2017) on the quantity and quality of garlic bulbs at harvest was studied. Garlic bulbs harvested from plots drenched with fluopyram in the fall had significantly less root plate damage, fewer nematodes in harvested bulbs, higher total yield weight and number of marketable bulbs than bulbs harvested from plots drenched with fluopyram in the spring only, water and abamectin drenched in the fall, spring or both fall and spring. Drenching fluopyram in both the fall and spring also resulted in less root plate damage, fewer nematodes in harvested bulbs, higher total yield weight and higher number of marketable bulbs than bulbs harvested from plots drenched with fluopyram in the spring only or water drenched in the fall, spring or both fall and spring, and abamectin drenched in the fall or spring, however the improvement at harvest could be attributed to the fall drench regardless if followed with a second drench the following spring since very little improvement was observed with a single spring drench.

NOTES

Invited Oral – Abstract #1

Sugar beet response to rotation and conservation management in a 12-year irrigated study in southern Alberta

Francis J. Larney*[1], J.J. Nitschelm[2], P.J. Regitnig[3], R.E. Blackshaw[1] and N.Z. Lupwayi[1]

[1]Agriculture & Agri-Food Canada, 5403 1st Ave. S., Lethbridge, AB T1J 4B1;
[2]Alberta Agriculture & Forestry, 5401 1st Avenue South, Lethbridge, AB T1J 4V6;
[3]Lantic Inc., 5405 64th Street, Taber, AB T1G 2C4.

francis.larney@agr.gc.ca

Sugar beet (*Beta vulgaris* L.) has a long history as an option for irrigated crop rotations in southern Alberta. A 12-yr (2000 - 2011) study compared conservation (CONS) and conventional (CONV) management for sugar beet in 4- to 6-yr rotations which also included dry bean (*Phaseolus vulgaris* L.), potato (*Solanum tuberosum* L.), and soft white spring wheat (*Triticum aestivum* L.). Oat (*Avena sativa* L.) and timothy (*Phleum pratense* L.) were included in the longest 6-yr rotation. Conservation management incorporated reduced tillage, cover crops, feedlot manure compost addition, and solid-seeded dry bean. Compared with a 4-yr CONV rotation (52.2 Mg ha^{-1}), sugar beet root yield (averaged over the second 6 yr of the study, 2006 - 2011) was significantly higher, by 11%, on 4- and 5-yr CONS rotations (57.7 - 57.9 Mg ha^{-1}), and by 8% on a 6-yr CONS rotation (56.1 Mg ha-1). Sugar beet impurity parameters were significantly affected by rotation in, at most, 3 of 12 yr. Integrating CONS management practices into sugar beet rotations led to significant yield benefits while effects on sugar beet quality were minimal.

NOTES

Oral – Abstract #110

Phosphorous requirements in an onion and carrot crop rotation over time

Mary Ruth McDonald*[1], K. Vanderkooi[1], D. Nemeth[2]

[1]Department of Plant Agriculture, University of Guelph, Guelph, ON, N1G 2W1 Canada;
[2]Ontario Ministry of Agriculture, Food and Rural Affairs, Guelph, ON, Canada.

mrmcdona@uoguelph.ca

High phosphorus (P) levels in rivers and lakes in southern Ontario are an environmental concern. Runoff and leached P from agricultural areas can be a source of this excess P. Trials were established in the Holland Marsh, Ontario, to evaluate the need to apply P fertilizer in commercial vegetable production in this region and determine how many years it takes to reduce P levels in these soils. Field trials were established on high organic matter soil (6.4%, pH 6.6). in 2010 and a carrot and onion crop rotation was followed each year. Phosphorous treatments were 100 kg ha-1 phosphate applied as monoammonium phosphate (MAP) preplant, or no phosphorous. Crops were seeded, maintained and harvested following grower practices. Phosphorous levels were very high, over 140 ppm, at the start of the trial and did not fall below 60 ppm until the postharvest assessment in 2015. Levels in both treatments were ~ 45ppm in 2016, but were higher (75 ppm) in 2017There were no differences in yield or marketable yield of onions until 2017, when the no phosphorous treatment had lower yield (19.3 t ha-1) than the treatment receiving 100 kg ha-1 P (34.4 kg ha-1). Onion yield was low overall in this trial. There were no yield differences in carrots in any year, and yields were consistent with commercial growers (56 - 81 t ha^{-1}). Current recommendations for P application to muck soils are accurate. It can take many years for P levels in soil to decrease with regular crop production.

NOTES

Oral – Abstract #113

Yield response to application of phosphorus and mycorrhizae varies with crop type

Umbrin Ilyas**[1], M.N. Raizada[1], L. du Toit[2], and M.R. McDonald[1].

[1]Department of Plant Agriculture, University of Guelph, Guelph, ON, N1G 2W1 Canada;
[2]Department of Plant Pathology, University of Washington State, Washington, WA 98273-4768 USA.

uilyas@uoguelph.ca

Phosphorus (P) is an essential plant nutrient but it is difficult to uptake from soil. Soon after application of P fertilizer, P adsorbs on soil minerals, becoming unavailable to plants despite increasing soil P content. Mycorrhizae (AM) solubilize adsorbed P from the soil and transfer it to the plant. This study evaluated the potential of AM to reduce the application of P fertilizer and increase yield of carrots and onions. Field trials were conducted on high organic matter soils with two levels of P: low (~46 ppm) and moderate (~68 ppm) near Bradford, ON. Treatments were seed pre-coated with AM (3 -5 propagules of *Glomus intraradices* Schenck & Sm/seed) with and without P fertilizer. Neither P nor AM was applied to the control. Phosphorus content of foliage and soil was analysed to determine the P uptake. In onions, yield and marketable yield increased with the application of P compared to the control. Phosphorus content was sufficient in onions when AM was applied without P compared to the control. In carrots, soil P content was reduced (19%) when AM was applied along with P compared to P alone. The results indicated that onions have a greater dependency on external application of P and AM. In comparison, carrots may extract nutrients more efficiently from soil and reduce soil P content while maintaining yield. Our study supports that AM can increase P uptake of the plant and reduce soil P content, but these outcomes may vary with crop type.

NOTES

Oral – Abstract #116

Understanding the molecular basis of phytonutrient composition differences in organically grown tomatoes

Amit Dhingra*[1], Richard M Sharpe[1], Luke Gustafson[1], Seanna Hewitt[1], Benjamin Kilian[1], James Crabb[1], Christopher Hendrickson[1], Derick Jiwan[1], Preston Andrews[1]

[1]Department of Horticulture, Washington State University, Pullman, WA 99164.

adhingra@wsu.edu

Enhanced levels of antioxidants, phenolic compounds, carotenoids and vitamin C have been reported for several crops grown under organic fertilizer, albeit with yield penalties. As organic agricultural practices continue to grow and find favor it is critical to gain an understanding of the molecular underpinnings of the factors that limit the yields in organically farmed crops. In this study, phytochemical and transcriptomic analysis was performed on mature fruit and leaf tissues derived from *Solanum lycopersicum* L. 'Oregon Spring' grown under organic and conventional fertilizer conditions to evaluate the following hypotheses. 1. Organic soil fertilizer management results in greater allocation of photosynthetically derived resources to the synthesis of secondary metabolites than to plant growth, and 2. Genes involved in changes in the accumulation of phytochemicals under organic fertilizer regime will exhibit differential expression, and that the growth under different fertilizer treatments will elicit a differential response from the tomato genome. Both these hypotheses were supported, suggesting an adjustment of the plants' metabolic and genomic activity in response to different nitrogen regimes. Organic fertilizer treatment resulted in activation of photoinhibitory processes through differential activation of nitrogen transport and assimilation genes resulting in higher accumulation of phytochemicals. This information can be used to identify alleles that allow for efficient utilization of organic inputs for breeding crops that are acclimatized to organic inputs.

NOTES

Oral – Abstract #115

The impact of chloroplast ultrastructure and thylakoid architecture on photosynthetic rates of *Amaranthus blitum* varieties

Elena Benic**[1], K.K. Tanino[1] and G.R. Gray[1]

[1]Department of Plant Sciences, University of Saskatchewan, Saskatoon, SK Canada S7N 5A8.

elena.benic@usask.ca

The process of photosynthesis occurs in the chloroplast. Ultrastructurally, the chloroplast consists of thylakoid membranes surrounded by an aqueous stroma. The thylakoids are organized into appressed (granal lamellae) and non-appressed (stromal lamellae) regions that results in an architecture forming a continuous luminal network that contains the components of electron transport. However these components are not distributed homogeneously resulting in a lateral heterogeneity that optimizes photosynthetic efficiency (QY) and capacity (Pmax). The objective of this research was to evaluate the impact of chloroplast ultrastructure and thylakoid architecture in an attempt to explain differential photosynthetic rates observed between red and green vegetable varieties of *Amaranthus*. Photosynthetic rates were examined using O2 evolution, whereby the red variety showed a 1.2-fold increase in QY and a 1.5-fold increase of Pmax in comparison to the green variety. Analyses of thylakoid architecture revealed that the granal index, which expresses appressed thylakoids as a percentage of total thylakoids and stackness (thylakoids/granum) in bundle sheath cells were both approximately 2-fold greater in the red than in the green variety. Additionally, chloroplast ultrastructural analyses revealed the presence of peripheral reticulum, cytoplasmic protrusions and crystalline inclusions in various cell types of the green variety. These structures are thought to enhance photosynthesis by increasing overall plastid area and inner envelope membrane surface area, although we see no evidence of this reflected in QY and Pmax. These results suggest that thylakoid architecture has an impact on QY and Pmax in *Amaranthus*.

NOTES

Oral – Abstract #122

Male sterility in tomato: Physiology, molecular mechanisms and use in hybrid seed industry

Vipen Sawhney*[1], Inder Sheoran[2], Vahid Omidvar[3] and Martin Fellner[3], Anna Pucci and Andrea Mazzucato[4]

[1]Department of Biology, University of Saskatchewan, Saskatoon, S7N 5C8.
[2]University of Toronto, Mississauga, ON;
[3]Palacky University, Czech Republic;
[4]University of Tuscia, Italy.

vipen.sawhney@usask.ca

A photoperiod-sensitive male-sterile 7B-1 mutant in tomato produces abnormal stamens in long days under field conditions. Pollen development is arrested in the mutant prior to meiosis, stamens are short, and the stigma is exposed for easy pollination. In short days (8-10 hours light), 7B-1 flowers produce normal stamens with viable pollen that can be used to pollinate mutant flowers resulting in 100% pure male-sterile seed. Plants raised from this seed can then be used as female parent for hybrid seed production there by eliminating the laborious process of hand emasculation. 7B-1 mutant is also resistant to high osmoticum, various salts, and low temperature, as tested by seed germination responses, which further makes it an ideal candidate for tomato hybrid seed programs. Comparative proteomic and transcriptomic analyses of 7B-1 and WT stamens revealed that in the mutant, the expression of a number of genes and proteins regulating tapetum development, especially proteases, is altered and this contributes to a delay in tapetum degeneration thus affecting pollen development and causing male sterility. In particular, cystatin, an inhibitor of cysteine protease, was over expressed both at the protein and transcript levels, and was a major factor affecting sterility. Genetic analyses have shown that 7B-1 is not allelic to stamenless (sl), or variable male sterile (vms) genes but is allelic to sl2. These data provide further insights into the location and functioning of the 7B-1 gene and should further help for its use in hybrid seed production in tomato.

NOTES

Poster – Abstract #201

Screening of root-knot nematode resistant carrot lines for resistance to carrot cyst nematode

Tyler Blauel*[1], Philipp Simon[2], and Mary Ruth McDonald[1]; [1]Department of Plant Agriculture, University of Guelph, 50 Stone Road East, Guelph, Ontario, N1G 2W1, Canada; [2]USDA- ARS, Madison, WI, USA (PS). tblauel@uoguelph.ca

Crop resistance is an effective method for managing plant-parasitic nematodes (PPN). Carrot lines that are resistant to some species of root-knot nematodes (Meloidogyne species) may also be resistant against other PPN, such as the carrot cyst nematode (CCN). Both root-knot and carrot cyst nematodes parasitize carrots, reducing marketability and overall yield, and are often found in soils where carrots are grown. The objective of this study was to determine the resistance of root-knot nematode resistant carrot lines to carrot cyst nematodes. Ten root-knot resistant carrot lines from the United States Department of Agriculture (USDA) carrot breeding program were assessed along with the commercial cultivar 'Cellobunch' in both high organic matter (muck) soil and sand. Tall narrow pots (conetainers) were seeded with 2 seeds per pot and thinned to one. The conetainers were arranged in a randomized complete block design with 5 replications and 14 containers per replicate line. Carrots planted in sand were inoculated with 75 CCN eggs per carrot. The muck soil was naturally infested with approximately 550 CCN juveniles and 200 cysts per carrot. Carrots were also seeded in noninfested soil as an untreated check. Carrots were grown outside during the summer months for 90 days before harvest. Disease incidence and severity, gall ratings, and nematode reproduction were recorded and top and root weight of carrots in infested soil was compared to those in non-infested soil. Any resistance identified will contribute to the carrot breeding program of the USDA and also carrot breeding for Canadian production.

Poster – Abstract #204

Integrating host resistance with fungicides for management of downy mildew (*Pseudoperonospora cubensis*) in pickling cucumber

Trueman, C.L.*[1], Sullivan, J.[2], Riddle, R.[2] [1]University of Guelph, Ridgetown, ON, Canada; [2]University of Guelph, Simcoe, ON, Canada. ctrueman@uoguelph.ca

Cucurbit downy mildew (CDM) (*Pseudoperonospora cubensis*) is an important cucumber disease in Ontario, Canada. Resistant hybrids 'Citadel' and 'Peacemaker' may allow for longer fungicide application intervals. Early (E) and late (L) seeded trials were completed at Ridgetown (RT) and Simcoe (SI) to evaluate these hybrids and susceptible 'Vlaspik' using no fungicide, and seven, 10, and 14-day intervals. Non-linear regression of interval response showed peak severity, measured by standardized area under the disease progress stairs (sAUDPS), for all hybrids occurred between the 10 and 14 day intervals at SIL and at the 14-day interval at RTL. 'Peacemaker' had 34% lower severity than 'Citadel' at SIL, where disease pressure was highest. Fungicide application reduced sAUDPS compared to no fungicide for 'Vlaspik' using any interval, all intervals except the 14-day at RTL for 'Citadel', and all intervals at SIL and RTL for 'Peacemaker', except the 14-day interval at RTL. Fungicide application increased marketable yield by 2.1 to 4.8 times compared to no fungicide for 'Vlaspik' using seven and 10-day intervals at RTL and seven, 10, and 14-day intervals at SIL, but not for 'Citadel' and 'Peacemaker'. There was no yield by interval response for 'Vlaspik'. Fungicide applications increased revenue compared to no fungicide for 'Vlaspik' using 10-day intervals at RTL and seven, 10, and 14-day intervals at SIL, but there was no interval response. Revenue for 'Citadel' and 'Peacemaker' was unaffected by fungicide application. CDM resistant hybrids offer potential to reduce fungicide use. Additional trials are underway to assist in developing grower recommendations.

Poster – Abstract #205

Evaluation of disease forecasting models and cultivar susceptibility to manage leaf curl (*Colletotrichum fioriniae*) of celery in Ontario

Stephen Reynolds[1]**, M. J. Celetti[2], K. Jordan[1], M. R. McDonald[1]. [1]Department of Plant Agriculture, University of Guelph, 50 Stone Road East, Guelph, ON, N1G 2W1, Canada; [2]Ontario Ministry of Agriculture, Food and Rural Affairs. sreyno01@uoguelph.ca

Leaf curl on celery (*Apium graveolens* L.), caused by the fungal pathogen Colletotrichum fioriniae, is characterized by lesions on the petioles and by crown rot, both which reduce the marketable yield of celery. The objectives were to improve the management of celery leaf curl by: identifying effective disease forecasting models for timing fungicide applications, and screening for cultivar resistance. Field experiments were conducted in 2016 and 2017 at the Holland Marsh. Disease forecasting models evaluated were: TOMCAST with a threshold of 15 DSV (disease severity value), TOMCAST 25 DSV, the strawberry anthracnose model (SAM) with a threshold of INF (predicted proportion of fruit) >0.15, and BOTCAST at a cumulative disease severity index of 21. A calendar spray and a no-spray control were included. The fungicide Quadris Flowable (azoxystrobin 25%) alternated with Switch 62.5WG (cyprodinil 37.5% and flud ioxonil 25.0%) were applied when recommended by the models. Disease pressure was high in 2016 and TOMCAST was effective as the calendar spray program, but with fewer sprays. In 2017, disease pressure was lower. TOMCAST and SAM were both effective, while BOTCAST was not suitable for predicting disease risk. Twelve cultivars were evaluated for their resistance to C. fioriniae. Cultivars 'Geronimo', 'Merengo', 'TZ 6010' and 'Hadrian' were the least susceptible, while cultivars 'TZ 9779', 'Stetham' and 'Kelvin' were the most susceptible. Leaf curl can be managed effectively using a TOMCAST disease forecasting model, and selecting cultivars that are the least susceptible to infection.

Poster – Abstract #206

Evaluation of new chemistries for the control of stem and bulb nematode in garlic

Lilieth Ives*[1], M. Celetti[2], K. Jordan[1], and MR. McDonald[1].

[1]Department of Plant Agriculture, University of Guelph, 50 Stone Road East, Guelph, Ontario, N1G 2W1, Canada; [2]Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), Guelph, Ontario, N1G 2W1, Canada. lives@uoguelph.ca

Stem and bulb nematodes (SBN), *Ditylenchus dipsaci*, are a problem for garlic growers in Ontario as this nematode reduces yield and infests seed cloves for successive planting. There are no resistant garlic cultivars and no nematicides registered for garlic seed cloves in Canada, thus chemical products must be evaluated for managing this nematode. Field trials were conducted on both muck (high organic matter) and mineral soil, in southern Ontario. The objective of these trials was to evaluate the efficacy of different chemical products as soak, seed fumigant or in-furrow drench treatments in garlic cloves naturally infested with SBN. The treatments were: abamectin, aluminum phosphide, fluensulfone, fluopyram, and thyme oil. An untreated check and a check of clean seed were also included. At harvest, bulbs were counted, weighed, and rated for nematode damage. Significant differences in total and marketable yields were found among the treatments at both sites. All treatments containing fluopyram resulted in significantly higher yields than the other treatments, including the clean seed. Differences in nematode counts from soil and plant tissue were found at both sites. Fluopyram applied as a soak or drench resulted in greatest reduction of nematodes recovered from plant and soil. Abamectin applied as a soak also provided good nematode control, while soil treatments with thyme oil and abamectin were ineffective. On muck soil there was a positive correlation between nematodes/kg soil and the disease severity index. These studies demonstrate that control of SBN may be obtained by soak and drench applications of fluopyram.

Poster – Abstract #208

Identifying clubroot resistance in canola and vegetable cultivars

Sarah C. Drury*[1], Mary Ruth McDonald[1] and Bruce Gossen[2]
[1]Department of Plant Agriculture, University of Guelph, 50 Stone Road East Guelph, Ontario, Canada N1G 2W1;
[2]Agriculture and Agri-Food Canada, 107 Science Place Saskatoon, Saskatchewan S7N 0X2.drury@uoguelph.ca

Clubroot, caused by the obligate parasite *Plasmodiophora brassicae* Woronin, can reduce the yield of canola and *Brassica* vegetables by up to 100%. Once *P. brassicae* is present in a field, eradication is difficult, leading to the use of resistant cultivars as a cost-effective and environmentally-friendly method of managing the disease. However, resistance is pathotype specific and can be broken down due to selection pressures causing *P. brassicae* populations to evolve over time. Resistance to clubroot was assessed in Ontario-grown canola (*Brassica napus* L.) and vegetable cultivars in organic soil naturally infested with *P. brassicae* pathotype 2 at the Muck Crops Research Station (King, Ontario). A first trial tested resistance in five canola cultivars from Bayer Crop Science and two control cultivars. A second trial evaluated clubroot resistance in susceptible and resistant cultivars of cabbage (*B. oleracea* v ar. capitata), cauliflower (*B. oleracea* var. botrytis), broccoli (*B. oleracea* var. italica), napa cabbage (*B. rapa* var. pekinensis and *B. rapa* var. chinensis) and rutabaga (*B. napus* var. napobrassica). To assess resistance or susceptibility, shoot weight, clubroot incidence and disease severity index were determined on 50 plants per replicate in the canola trial and on 30 plants per replicate for the vegetable trial, six weeks after seeding or transplanting. Screening clubroot resistance in canola and Brassica vegetable cultivars will help Ontario growers to select cultivars based on which pathotype is present in fields with clubroot infestations. This research will contribute to more consistent yields and sustainable production.

Poster – Abstract #209

The Effect of Wavelength Specific Lighting and CO2 Concentration on Whole Plant CO2 and H2O Gas Exchanges

Jason Lanoue*[1,2], Evangelos D Leonardos[1], Xiao Ma[1], Shalin Khosla[3], Xiuming Hao[2], Bernard Grodzinski[1] [1]Department of Plant Agriculture, University of Guelph, Guelph, Ontario, Canada; [2]Harrow Research and Development Centre, Agriculture & Agri-Food Canada, Harrow, Ontario, Canada; [3]Ontario Ministry of Agriculture, Food and Rural Affairs, Harrow, Ontario, Canada. jlanoue@uoguelph.ca

Much research is available on the wavelength specific responses of leaves from multiple crops when exposed to long-term wavelength specific lighting. However, leaf responses to environmental stimuli do not always extrapolate linearly to whole plant responses due to the complexities of the plant canopy, namely mutual shading and leaves of different ages. For these reasons, we measured the diurnal whole plant CO2 and H2O gas exchange of different plants species under long-term and short-term exposure to various spectral qualities and CO2 conditions. It was determined that within each environmental stimulus provided to the plant, biomass gain throughout the day was similar when plants were measured under high-pressure sodium (HPS), red-blue LED, or red-white LED. Under all luminary systems, plants showed a similar diurnal pattern of transpiration, rising to a maximum around mid-day and declining during the rem ainder of the photoperiod, a circadian rhythm which was not observed in net carbon exchange patterns. Whole plant water-use efficiency values of plants exposed to either red-blue or red-white LED lighting was lower compared to plants exposed toe HPS lighting. The decrease in WUE from plants exposed to both LED systems was ubiquitous within all lighting and CO2 conditions tested. Principle component analysis of whole plant tomato measurements further indicate that increases in CO2 concentration affect photosynthesis more so than transpiration which is more so affected by spectral quality. Whole plant analyses can aid in deepening our physiological understanding of canopy interactions with changing environmental parameters and aid in optimizing controlled environment growth conditions.

Poster – Abstract #210

Evaluation of onion disease forecasting models through the use of remote weather stations in Southern Ontario.

Jake Allan Carson*[1], Bruce D. Gossen[2], Andrew Gadsden[1], Mary Ruth McDonald[1]

[1]Department of Plant Agriculture, University of Guelph 50 Stone Road East, Guelph ON N1G 2W1; [2]Agriculture and Agri-Food Canada, 107 Science Place Saskatoon, Saskatchewan S7N 0X2. jcarso05@uoguelph.ca

Stemphylium leaf blight (SLB) and onion downy mildew (ODM), caused by *Stemphylium vesicarium* and Peronospora destructor, respectively, are two diseases that can cause devastating onion crop losses in Canada. Disease forecasting models have been developed for ODM (gDowncast and dvgDowncast) and are in development for SLM based on TOMcast and BSPcast. These models determine when fungicides should be applied based on environmental conditions favorable for disease development. This allows for more precise spraying, which decreases input costs and the risk of the development of fungicide insensitivity. Forecasting for ODM has been successful in the Holland Marsh, in combination with scouting and spore trapping, but it is not known if the models will be effective for remote locations. HOBO U30 Remote Monitoring Systems equipped with smart sensors were placed in three onion fields throughout the Holland, Keswick, and Grand Bend marshes, where a majority of Ontario's onion production occurs. The local weather data served as input to the models TOMcast, BSPcast, gDowncast, and dvgDowncast to determine predicted disease pressure. Disease assessment plots consisting of 100 onion plants were marked in eight fields, with 4-10 replications per field. Weekly evaluations were conducted to determine disease incidence and pathogen spread, and plant samples were collected weekly to confirm the presence of pathogens. Comparisons were made between model predictions and disease observed in fields to evaluate the accuracy of the disease model in these remote areas.

Poster – Abstract #213

Metal catalyzed hydrogen peroxide seed treatment enhances germination and growth in basil, cilantro and carrots

Eric Rae[1]**, Rensong Liu[1], Bernard Laarveld[2], Andrew Olkowski[2], Pankaj Banik[3], Brian Bain[4] and Karen Tanino[1]
[1]Dept. Plant Sciences, University of Saskatchewan, 51 Campus Drive, Saskatoon, SK S7N 5A8; [2]Dept. Animal and Poultry Science, University of Saskatchewan, 51 Campus Drive, Saskatoon, SK S7N 5A8; [3]Global Institute for Food Security, 110 Gymnasium Place, Saskatoon, SK; [4]Ecobain Naturals, 115 343, 70 St, Saskatoon, SK. eric.rae@usask.ca

Germination enhancing seed treatments are an intriguing option for decreasing the time between planting and harvest for a variety of horticultural crops. The objectives of this work were to 1) Assess the impacts of a metal catalyzed hydrogen peroxide seed treatment on the germination of basil, cilantro and carrots. 2) Determine how the seed treatment effects the whole plant growth of cilantro and carrots. To accomplish these goals germination of treated and control seeds from each species was tracked for two weeks in a temperature controlled chamber in the dark at 22.5C. Treated and control carrot seeds were also grown in pots while cilantro was grown hydroponically under a 18:6 day-night cycle. In cilantro, plant height, leaf number and branches were recorded after two weeks of growth. In carrots, plants were harvested every two weeks to measure root growth. Preliminary results indicated that soaking basil , cilantro and carrot seeds with the metal catalyzed hydrogen peroxide treatment enhanced germination. In cilantro the seed treatment significantly increased leaf number allowing for commercial harvest 40% earlier than for controls. Preliminary results have also demonstrated enhanced root growth in treated seeds compared to controls. These results demonstrate that the seed treatment may have potential applications in enhancing commercial herb, cannabis and horticultural crop production.

Poster – Abstract #215

Fungicide application timing for the control of *Stemphylium* leaf blight of onion using disease forecasting models

Sara Stricker[1]**, Mary Ruth McDonald[1], Bruce Gossen[2] [1]Department of Plant Agriculture, University of Guelph 50 Stone Road East, Guelph ON N1G 2W1; [2]Agriculture and Agri-Food Canada, 107 Science Place Saskatoon, Saskatchewan S7N 0X2. strickes@uoguelph.ca

Stemphylium leaf blight, caused by *Stemphylium vesicarium*, is a devastating foliar disease of onions that can cause complete defoliation and lead to small, unmarketable bulbs with reduced capacity for long term storage. Growers typically use a calendar-based schedule to apply fungicides, which does not depend on weather conditions or pathogen biology. This can result in more applications than necessary, which is not economical for the grower, and can increase the risk of fungicide insensitivity developing in the pathogen population. Forecasting models use environmental factors to predict conditions that are conducive to pathogen development, and to recommend when pesticides should be applied. When used correctly, forecasting models can provide disease control equal to calendar-based methods. This field trial assessed the disease severity of seven fungicide timing treatments compared to an untreated check. T he onions were direct seeded into organic soil at the Muck Crops Research Station (King, Ontario). The treatments included: two fungicide seed treatments (penflufen and azoxystrobin) followed by foliar sprays every 7-10 days, weekly foliar sprays with two different starting dates (2-leaf or 4-leaf growth stage), a mineral oil drench at emergence followed by weekly foliar sprays, and two forecasting models (modified versions of previously published TOMcast and BSPcast). The foliar fungicide treatment was Quadris Top (difenoconazole and azoxystrobin) alternated with Luna Tranquility (fluopyram and pyrimethanil). Disease severity and yield were assessed. This research will contribute to recommendations for effective disease management to improve yields and to stabilize the quality of onions for long-term cold storage.

Poster – Abstract #220

New carrot weevil activity and behaviour in Canada

Zachariah Telfer[1], **Alexandra Stinson*[2]**, Cynthia Scott-Dupree[2], and Mary Ruth McDonald[1]

[1]Department of Plant Agriculture, University of Guelph, Guelph, Ontario, Canada N1G 2W1; [2]School of Environmental Sciences, University of Guelph, Guelph, Ontario, Canada N1G 2W1. ztelfer@uoguelph.ca

The carrot weevil, *Listronotus oregonensis* (LeConte), is a major carrot pest in Canada. According to past research, the carrot weevil has a single generation in Canada, ovipositing through May to early July, and only oviposits on plants that have reached the 4th true leaf stage or older. Carrot weevil larvae feed on the carrot root, rendering the root unmarketable due to tunneling damage. Recent issues in carrot weevil control are high (>10%) damage observed at harvest, young carrot mortality due to larval feeding, and a new, second generation of carrot weevil. From 2016-2018, trials were conducted at the University of Guelph's Muck Crops Research Station to assess these issues through seeding date trials and carrot weevil monitoring. In seeding date trials, oviposition on plants at the 1st true leaf stage was observed, and early seeded plots had significantly higher dead carrots and carrot weevil da mage. In 2016, carrot weevil damage also increased between late July and October, meaning oviposition was occurring later in the season which is indicative of a second generation. Carrot root baits were used to track carrot weevil oviposition and some oviposition was detected in July and October in 2016 and 2017. However, as the carrots grow, the root sections tend to get outcompeted by the crop meaning as the season progresses the root sections likely underestimate carrot weevil oviposition. These trials are being repeated in 2018. Future research should examine if insecticide applications can protect seedlings from mortality caused by carrot weevil and investigate alternate attractants or monitoring techniques for carrot weevil. With the potential second generation, mid to late season insecticide applications may also be required, however the dense carrot canopy may complicate the efficacy of these treatments.

Poster – Abstract #225

Soil profile distribution of stem and bulb nematode (*Ditylenchus dipsaci*) and comparison of extraction method from soil

Celetti Michael J.*[1], Paibomesai M.[1], Hughes B. R.[2] and Zandstra J. [1]Ontario Ministry of Agriculture, Food and Rural Affairs, Guelph, Ontario. [2]University of Guelph, New Liskard, Ontario. [3]University of Guelph, Ridgetown, Ontario. michael.celetti@ontario.ca

Stem and bulb nematode (*Ditylenchus dipsaci*) is a major pest of garlic grown in Ontario. A study was conducted to determine the distribution of *D. dipsaci* and root parasitic nematodes in the soil profile of fields that had previously grown garlic and compare nematode extracting methods from soil. The top 5 cm of soil samples taken by inserting a 2.5 cm diameter hollow core soil probe into the soil to a depth of 20 cm was collect in a bucket. The remaining soil core from 5-20 cm deep was collected in a separate bucket. Approximately 50 to 60 soil cores/field were collected from 14 fields. Fifty grams of each sample/profile depth/field was used to extract nematodes utilizing the modified Baermann Pan method. One hundred ml of each sample/soil profile depth/field were weighed and used to extract nematodes utilizing the rapid centrifugal-flotation technique. Nematodes extracted were identified to genus with a compound microscope using morphological criteria and enumerated from each sample/soil profile depth/field/method. Significantly more *Ditylenchus* sp. nematodes were extracted from the top 5 cm of the soil profile compared to 5 – 20 cm depth whereas significantly more *Pratylenchus* sp. and total root parasitic nematodes were extracted from 5-20 cm depth than the top 5 cm of the soil profile. The modified Baermann Pan method extracted significantly more *Pratylenchus* sp. from the soil than the rapid centrifugal-flotation technique whereas the rapid centrifugal-flotation technique extracted significantly more *Ditylenchus* sp. and *Helicotylenchus* sp. from the soil.

Poster – Abstract #226

Effect of treating *Ditylenchus dipsaci* infested garlic cloves with fluopyram, abamectin or exposing infested cloves to aluminum phosphide gas prior to planting on the quality and quantity of bulbs at harvest

Michael J. Celetti*[1] and Cranmer[1], T.J. [1]Ontario Ministry of Agriculture, Food and Rural Affairs, Guelph Ontario. michael.celetti@ontario.ca

Stem and bulb nematode (*Ditylenchus dipsaci*) is a difficult pest to manage in garlic. To evaluate treatments to manage this pest, garlic cloves cv. Music infested with *D. dipsaci* (832 nematodes/g dried clove) were soaked in water alone for 2 and 4 hours; a solution of 0.4 grams fluopyram/L water for 1 and 2 hours; 0.072 grams abamectin/L water + 0.25% non-ionic surfactant (v/v) for 4 hours or treated with 0.4 grams fluopyram in 100 ml of water/kg garlic cloves to coat the cloves evenly prior to planting. Nematode infested garlic cloves were also exposed to aluminum phosphide gas (55%) in a 2.26 m^3 enclosed space for 72 hours at 29^oC. Treated cloves were planted in the fall (2016). Nematode-free garlic cloves were planted for comparison. Bulbs harvested from plots planted with nematode-free cloves had significantly less root plate damage and higher total yield weight than bulbs harvested from plots planted with nematode invested cloves soaked in water for 1 or 2 hours, abamectin solution for 4 hours, fluopyram solution for 2 hours or exposed to aluminum phosphide gas prior to planting. Significantly fewer nematodes were extracted from bulbs harvested from plots planted with nematode-free cloves or nematode infested cloves soaked in a solution or coated with fluopyram prior to planting. Soaking nematode infested cloves in fluopyram for 1 hour or coating with fluopyram prior to planting significantly reduced root plate damage, nematodes in bulbs and improved the total weight of bulbs and number of marketable bulbs at harvest.

Poster – Abstract #227

Comparative study of *Ilyonectria* sp. virulence causing replant failure in American ginseng (*Panax quinquefolius*)

Behrang Behdarvandi[1]** and Paul H. Goodwin[1] [1]School of Environmental Sciences, University of Guelph, Guelph, Canada. bbehdarv@uoguelph.ca

Ginseng replant failure results in high levels of root rot in fields previously used for ginseng production. The root rot is primarily caused by *Ilyonectria* sp., and it has been proposed that *I. mors-panacis* isolates are more prevalent in ginseng roots because they are more virulent to ginseng than other *Ilyonectria* species. Among sixteen *Ilyonectria* isolates collected from infected ginseng roots grown on replant or non-replant soil in Ontario and British Columbia, 12 isolates were *Ilyonectria mors-panacis* and 4 isolates were *I. rubosta* based on their histone H3 sequences. The *I. mors-panacis* isolates had a wider range of virulence but were on average no more virulent than *I. rubosta* isolates when spores were inoculated onto wounded roots. Roots treated with 20 mg/ml replant soil extract had significantly higher, lower or unchanged areas of root rot for 6, 4 and 6 of the isolates, respectively, compared to roots treated with water. Increasing the concentration of replant soil extract resulted in greater root rot, whereas higher concentrations of root or non-replant soil extracts did not. On average, *I. mors-panacis* isolates do not cause greater root rot than *I. rubosta* isolates. However, isolates of both species can cause more root rot when roots are first exposed to extracts from replant soil compared to being first exposed to water, non-replant soil extract and/or ginseng root extract. It appears that compounds released into the soil by American ginseng roots can persist in replant soil affecting the resistance of inoculated roots to *Ilyonectria* spp.

Poster – Abstract #231

The Effect of Wavelength Specific Lighting on Carbon Export in Tomato Leaves and the Implications for Inter-Canopy Lighting

Jason Lanoue*[1,2], Evangelos D Leonardos[1], Shalin Khosla[3], Xiuming Hao[2], Bernard Grodzinski[1]
[1]Department of Plant Agriculture, University of Guelph, Guelph, Ontario, Canada; [2]Harrow Research and Development Centre, Agriculture & Agri-Food Canada, Harrow, Ontario, Canada; [3]Ontario Ministry of Agriculture, Food and Rural Affairs, Harrow, Ontario, Canada.
jlanoue@uoguelph.ca

Advances in light-emitting diode (LED) technology over the past few decades have brought about the ability to fine-tune lighting systems for plant production in controlled environments. Translocation is an under-explored, fundamental process involving carbon and water balance affecting source/sink relationships. Source leaf strength is defined by photosynthesis and carbon export; both processes being essential for growth. The process of carbon export involves additional steps downstream of photosynthesis including multiple cell lines, enzymes, and transporters which can be environmentally regulated. Our primary objective was to examine diurnal patterns of photosynthesis and carbon export via $^{14}CO2$ steady-state labelling under different spectra generated by LEDs, but at similar CO2 influx rates. Daily patterns showed that photosynthesis and export were supported by all wavelengths of light tested including o range and green alone. Export in the light, under all wavelengths was always higher than that at night, varying from 65-83% of daily carbon fixation depending on light intensity. Photosynthesis and export were highly correlated under all wavelengths. Relative export decreased as photosynthesis increased under all wavelengths indicating an upper limit for export. Interestingly, only at a medium photosynthetic rate were differences found. At this rate, relative export under blue and orange LEDs were higher than under white and red-white LEDs. Understanding the phenotypic responses of the carbon export pathway to light can aid in the optimization and implementation of LED lighting systems, specifically for inter-canopy lighting, during controlled environment crop production.

Poster – Abstract #232

The effect of far-red (FR) enriched spectrum and end-of-day FR on tomato seedling in a controlled environment

Grazyna Bochenek[1], Fei Jia[1] and **Ida Fällström*[1]**
[1]Heliospectra, AB

ida.fallstrom@heliospectra.com

The red to far-red (FR) ratio has significant effects on plant morphology. FR promotes extension growth of the stem and leaf in various plant types. The ability to control plant morphology (e.g., plant height) can be of interest to commercial growers. Intelligent LED technology enables a high level of control over the amount and quality of light provided to plants as supplemental or sole-source lighting. Technology gives growers the possibility of non-chemical control of plant morphology. We investigated growth performance of tomato seedling (rootstock) 'Kaiser' and 'Emperador' grown in three LED lighting regimes: without FR, FR-enriched spectrum, and with FR only as a 30-minute end-of-day (EOD) treatment. The photosynthetic photon flux density (PPFD) was similar across lighting regimes; FR was added to provide the red-to-FR ratio of 8:1. The intensity of FR light in the EOD FR regime was the same as in the FR-enriched regime. The Heliospectra intelligent lighting system with the HelioCORE(TM) scheduling module was used. Preliminary results show that seedlings grown under EOD FR had a larger stem and leaf elongation than plants grown under FR-enriched spectrum. The results indicate that differences in growth performance should be expected as an outcome of applying different FR strategies. By adding FR at the end of the day, growers will also be able to reduce energy use. Smart LED lighting systems can be implemented for energy-efficient and non-chemical control of plant morphology. Keywords: growth performance, tomato seedling, EOD far-red, sole-source lighting, spectral quality, HelioCORE.

NOTES

CANNABIS SYMPOSIUM

Co-Sponsored by 7ACRES **and** HAWTHORNE GARDENING CO

FRIDAY OCTOBER 5. Oakes Grand Ballroom South (2nd floor Mezzanine Level)

Friday October 5				
8:00 AM	8:50 AM	Registration desk open	Oakes Grand Ballroom South (2nd floor, Mezzanine)	
8:50 AM	9:00 AM	Opening Remarks, Housekeeping announcements	Dr. Youbin Zheng (Chair)	Dr. Zheng will chair the whole day's activities.
9:00 AM	9:35 AM	Speaker 1-Invited	Dr. Linda Parker	Cannabinoids and the Brain
9:35 AM	10:10 AM	Speaker 2-Invited	Dr. Jonathan Page	A New Era of Cannabis Science
10:10 AM	10:30 AM	Speaker 3	Dr. Max Jones	Plant Regeneration from Female Flowers of *Cannabis sativa*
10:30 AM	11:00 AM	Refreshment Break		
11:00 AM	11:40 AM	Speaker 4-Invited	Dr. Hemant Lata	Propagating Elite Cannabis: A Current Scenario
11:40 AM	12:00 PM	Speaker 5	Mr. Kevin Piunno	Application of 3D Printing to Prototype and Develop Novel Liquid Micropropagation Systems
12:00 PM	12:10 PM	General Question period		
12:15 PM	1:30 PM	LUNCH		Oakes Grand Ballroom north (2nd floor, Mezzanine Level)
1:30 PM	2:10 PM	Speaker 6- Invited	Dr. Ernest Small	Ten Agricultural Priorities for Drug Cannabis
2:10 PM	2:30 PM	Speaker 7	Dr. Igor Kovalchuk	*Cannabis sativa* Strains with Anti-cancer Properties
2:30 PM	2:50 PM	Speaker 8	Dr. Deron Caplan	Improving Cannabis Yield and Quality through Horticultural Management
2:50 PM	3:20 PM	Refreshment Break		
3:20 PM	3:40 PM	Speaker 9	Dr. David Hawley	Improving Cannabis Bud Quality and Yield with Sub-canopy Lighting
3:40 PM	4:05 PM	Speaker 10	Mr. Matt Rogge	Lessons Learned from Large Scale Greenhouse Production of Medical Cannabis
4:05 PM	4:40 PM	Panel discussion	Dr. Hemant Lata, Dr. Linda Parker, Dr. Jonathan Page, Dr. Ernest Small and Mr. Matt Rogge	Questions from the audiences related to cannabis, such as breeding, propogation, production, commercialization and human application, can be addressed by the panelists and any person who has the answer and willing to contribute.
4:40 PM	5:00 PM	Book Signing	Dr. Hemant Lata, Dr. Linda Parker, Dr. Ernest Small	Interested audiences can purchase book in advance and bring them to the event for the authors to sign. All the books can be purchased online. Dr. Lata: Cannabis sativa L.- Botany and Biotechnology; Dr. Parker: Cannabinoids and the Brain; Dr. Small: Cannabis -A Complete Guide.
5:10 PM		Bus to Butterfly		
5:30 PM	6:15 PM	Conservatory	Bus to Banquet	
6:30 PM		BANQUET	Benchmark Restaurant	135 Taylor Rd., Niagara-on-the-Lake

Invited Oral – Abstract #11

Cannabinoids and the Brain: The Endocannabinoid System (ECS)

Linda A. Parker*[1],

[1]Department of Psychology, University of Guelph, 50 Stone Road East, Guelph, Ontario, N1G 2W1, Canada.

parkerl@uoguelph.ca

The cannabis plant has been used for recreational and medicinal purposes for more than 4,000 years, but the scientific investigation into its effects has only recently been fruitful. The discovery of Δ^{9}-tetrahydocannbinol (THC), the main psychoactive component of cannabis, and the further discovery of cannabinoid receptors led to the discovery of the endocannabinoid system. The brain produces chemicals similar to THC, which act on the same receptors as THC; this endocannabinoid system is involved in all aspects of brain functioning. Cannabis contains not only the psychoactive compound THC, but also other compounds of potential therapeutic benefit, and that one of them, cannabidiol (CBD), shows promise for the treatment of pain, anxiety, and epilepsy. The potential benefits/risks of cannabis use for human health will be discussed.

NOTES

Invited Oral – Abstract #6

A New Era of Cannabis Science

Jonathan Page*[1,2]

[1]Anandia Labs, BC, Canada

[2]Botany Department, The University of British Columbia

jonathan@anandialabs.com

https://www.anandia.ca

Anandia is using chemical phenotyping and genomics to better understand the genetic organization of the genus *Cannabis*. A major experimental approach has been the use of EST and transcriptome data derived from glandular trichomes, the specialized epidermal structures that synthesize cannabinoids. We have successfully applied trichome-focused analysis in combination with classical biochemistry to identify three enzymes of the cannabinoid pathway: hexanoyl-CoA synthetase, olivetolic acid cyclase and an aromatic prenyltransferase. A draft assembly of the ~820 Mbp genome from the marijuana strain Purple Kush, has opened up new avenues for gene discovery as shown by the identification of a novel cannabinoid synthase enzyme, cannabichromenic acid synthase. In addition, the genetic and biochemical basis of terpene production in now under investigation. We have recently used genotyping-by-sequencing (GBS) to analyze the genetic variation in hemp and drug-type (marijuana) accessions. GBS shows that hemp and marijuana are genetically distinct and provides insight into the differentiation of marijuana into "Indica" and "Sativa" groups. As cannabis emerges from the shadow of prohibition, genomics promises both to clarify its evolutionary history and to accelerate the breeding of this valuable, multi-use crop. Anandia is leading the global efforts to provide a strong scientific foundation for cannabis, and create new, high-value cultivars for commercial production.

NOTES

Oral – Abstract #119

Plant regeneration from female flowers of *Cannabis sativa*

Kevin Piunno[1], Gregory Golenia[2], Cassandra Downey[2], Ekaterina Boudko[2], **Max Jones*[2]**

[1]Department of Plant Agriculture, University of Guelph, 50 Stone Road East, Guelph, Ontario, N1G 2W1;
[2]Canopy Growth Corporation, 1 Hershey Drive, Smiths Falls, Ontario K7A 0A8.

amjones@uoguelph.ca

Cannabis sativa will be legal for recreational use in Canada starting October 17th, 2018. It is anticipated to be a multi-billion dollar industry and among the most economically important crops in the country. However, due to the legacy of prohibition, very little research has been done with this species and modern biotechnological tools widely used in other crops are in their infancy. Due to the biology of *C. sativa*, plant tissue culture and related technologies have significant potential for germplasm conservation, large-scale propagation, and genetic improvement of the crop. This seminar will highlight some of the recent collaborative research projects between Canopy Growth Corporation and the University of Guelph. Specifically, this seminar will present technologies to regenerate plants from immature and mature female flowers and discuss the implications this could have for developing modern breeding programs. In this study, immature (3 cultivars) and mature (1 cultivar) inflorescence explants were cultured on various levels of TDZ. Shoot development was observed to varying degrees in all three cultivars and from both immature and mature explants. These shoots developed roots and have been successfully transferred to the greenhouse, completing the cycle. This study provides the first report of in vitro shoot development from floral tissues in *C. sativa*. With further refinement, this could provide an alternative propagation method to help streamline breeding programs in short day plants and establish a clonal propagation system for day neutral cultivars.

NOTES

Invited Oral – Abstract #7

Propagating Elite Cannabis: A Current Scenario

Hemant Lata*[1]

[1]National Center for Natural Product Research, Research Institute of Pharmaceutical Sciences School of Pharmacy, University of Mississippi, USA MS-38677

hlata@olemiss.edu

Cannabis sativa L. belonging to family Cannabaceae, is an annual herb with origin in Central Asia, spreading to Europe, later introduced to America. It is a dioecious species. If grown from seeds, all genetic lines intercross producing different hybrids, which lead to continuous variation of the genetics within the genus. Due to its allogamous nature, cannabis is considered as highly complex species in terms of botany, genetics and chemistry. Consistency in chemical profile of biomass product however, is a key issue to develop a feasible, efficient and safe cannabis based phytopharmaceuticals. One of the major research interests of our group at The University of Mississippi is to continue screening and selecting the high yielding female clones based on their chemical profile and using vegetative and micropropagation techniques to conserve and mass-propagate those lines. In this presentation, cannabis botany and, the role of biotechnology and our efforts to propagate *C. sativa* for the production of phytocannabinoids will be discussed.

NOTES

Oral – Abstract #118

Application of 3D Printing to prototype and develop novel liquid micropropagation systems

Kevin F Piunno[1]** and Max. P. Jones[1]
[1]GRIPP Institute, Department of Plant Agriculture, University of Guelph, 50 Stone Road East, Guelph, Ontario, Canada N1G 2W1.

kpiunno@uoguelph.ca

Tissue culture is a useful for micropropagation, plant breeding, genetics, germplasm storage, pathogen removal, and conservation. However, micropropagation is relatively expensive compared to other clonal propagation methods, largely due to labour costs. Liquid cultures will be optimal for future automation, but systems must be designed to overcome the challenges in working with liquid media. Using 3D printing, CAD designs can be created, evaluated, and modified rapidly in an iterative trial and error process. With this method, three prototype liquid culture systems compatible with a previously designed vessel have been developed. The first module facilitates thin-film liquid culture using hydrostatic pressure and does not require pumps, motors or external components. The second module enables liquid culture during the rooting phase of micropropagation using a two-part scaffold to provide physical support t o plants in a liquid medium. This system has resulted in faster rooting and eliminates the need to wash media from the roots, reducing labour costs and avoiding damage. The third module is a small scale temporary immersion rocker that uses a stepper motor and Arduino microprocessor. This benchtop device fits on existing shelving units and gives researchers precise control of the motion and time parameters. Control of immersion time can lead to reduced hyperhydricity. Advances in liquid culture technology will reduce labour costs and the unit cost of micropropagated plants to make it more competitive with other methods.

NOTES

Invited Oral – Abstract #5

Ten agricultural priorities for drug Cannabis

Ernest Small*[1]

[1]Agriculture and Agri-Food Canada, 960 Carling Ave., Ottawa, Ontario, K1A 0C6.

ernie.small@agr.gc.ca

Because of marijuana prohibition for most of the last century, agricultural research and development of *Cannabis sativa* are greatly retarded by comparison with all other high-value Canadian crops. (1) The most pressing long-term need is assembly of a public permanent germplasm (seed) collection which will preserve vanishing genetic resources of cannabis plants and provide the essential basis for breeding. (2) With very few exceptions, the thousands of marijuana "strains" currently recognized fail to meet scientific and nomenclatural standards required for plant cultivars. Conventional cultivated crop classification needs to be applied to marijuana. (3) Over the last half-century, the Green Revolution strategy of increasing harvest index (high-value proportion) has greatly improved major crops. This architectural approach needs to be applied to cannabis. (4) Also, as with all major crops, molecular breeding needs to be undertaken with particularly regard to cannabinoid production. However, the widespread practice of breeding for terpene content needs to be reconsidered, since no terpene has been found to be unique to *Cannabis*, and terpenes are easily and much more cheaply simply added to cannabis products. (5) Inasmuch as cannabis is employed medicinally by immune-compromised patients, production practices affecting health and safety, such as control of pathological microorganisms and toxic elements absorbed from substrates, fertilizers and pesticides, need to be improved. (6) *Cannabis* grown for marijuana in sunless buildings and in greenhouses is the world's least sustainable crop, wasting huge amounts of energy for heat and light and generating greenhouse gases. Outdoor cultivation and more efficient greenhouse technologies are needed. (7) As the second most desired cannabinoid, cannabidiol (CBD) is in demand. Studies are needed to establish the comparative efficiency of harvest as a salvage product from hemp, from the flowering portions of high-CBD strains, or from the foliage. (8) Environmental control studies are required, particularly with regard to generation of weeds, gene escape from genetically transformed strains, odour control, and possible toxins contaminating soil and water from destruction of unused portions of the plants. (9) Consistent with the increasing practice of eliminating male plants and male flowers in bisexual cultivars, techniques for micropropagation of female clones, which are already developing rapidly, need to be expanded. (10) Cannabinoids make up as little as 5% of the dry weight of the entire plant, so that most of the material is wasted, and indeed needs to be destroyed according to regulations. Uses need to be found for the leftover biomass.

NOTES

Oral – Abstract #124

***Cannabis sativa* strains with anti-cancer properties**

Nuanying Zhang, DonpPing Li, Rocio Rodriguez Juarez, Olena Shymanovska[2], Darryl Hudson[2], Olga Kovalchuk, **Igor Kovalchuk*[1]**

[1] Department of Biological Sciences, University of Lethbridge, Lethbridge, AB, CANADA
[2] InPlanta Biotechnology, 16 Sandstone Rd. S., Lethbridge, AB, CANADA

igor.kovalchuk@uleth.ca

Cannabis sativa research is entering into a new phase in Canada and worldwide. At the same time, understanding of medicinal potential of various cannabis strains legs behind the legal developments. In the past two years we have generated several hundred cannabis hybrids. To analyze the potential medicinal properties of these plants, we have profiled 128 whole flower ethanol extracts prepared from new hybrids. We tested these extracts for anticancer activity using breast cancer cells HCC1806. We performed cell cycle arrest analysis, and identified 48 extracts with significant effect. We then used MTT assay to test cancer cell viability and confirmed 19 extracts to have strong effect. Analysis of cell viability and cell cycle arrest on WI38 and HuMEC normal cells demonstrated that corresponding concentrations of extracts had no effect. Preliminary data using several extracts that demonstrated efficiency on breast cancer lines also demonstrated similar efficiency in treatment of glioblastoma cells.

We have then analyzed the metabolic profile of these extracts and attempted to identify common patterns in metabolites concentrations and their ratios using machine learning. We have identified several interesting traits in metabolic profiles correlating with the efficiency of extracts against cancer cells. Our data thus indicate that cannabis flower extracts can be very effective in killing cancer cells and that there might be a specific metabolic pattern that is an indicator of potential effectiveness of given cannabis extract.

NOTES

Oral – Abstract #112

Improving cannabis yield and quality through horticultural management

Deron Caplan*[1], Mike Dixon[1] and Youbin Zheng[1]

[1]School of Environmental Sciences, University of Guelph, 50 Stone Road East, Guelph, Ontario, N1G 2W1, Canada.

dcaplan@uoguelph.ca

Because of the illicit nature of cannabis production, limited research exists on the horticultural management of this crop. In the past few years, we have evaluated horticultural management practices for cannabis production under controlled environment conditions. Our focus was on optimizing these practices to increase cannabis growth, yield and content of medically relevant secondary metabolites such as Δ^9-tetrahydrocannabinol (THC), cannabidiol (CBD) and some terpenoids. This presentation outlines some of our key findings on propagation through vegetative stem cuttings, formulation and evaluation of growing substrates, organic fertilization, and how controlled drought stress can be used to stimulate secondary metabolites. We question some commonly held beliefs on cannabis production and found that simple and environmentally sustainable horticultural management techniques can be used to stimulate secondary metabolites and yield in *Cannabis.*

NOTES

Oral – Abstract #126

Improving cannabis bud quality and yield with sub-canopy lighting

Dave Hawley*[1], Thomas Graham[1], Mike Stasiak[1], Mike Dixon[1]

[1] School of Environmental Sciences, University of Guelph, 50 Stone Road East, Guelph, Ontario, N1G 2W1, Canada.

dhawley@uoguelph.ca

The influence of light spectral quality on cannabis [*Cannabis sativa* L.] development is not well defined. It stands to reason that tailoring light quality to the specific needs of cannabis may increase bud quality, consistency, and yield. In this study, *Cannabis sativa* L. 'WP:Med (Wappa)' plants were grown with either no supplemental sub-canopy lighting (SCL) (control), or with red/blue ("Red-Blue") or Red-Green-Blue ("RGB") supplemental SCL. Both Red-Blue and RGB SCL significantly increased yield and concentration of total Δ^9-*THC* in bud tissue from the lower plant canopy. In the lower canopy, RGB SCL significantly increased concentrations of α-pinine and borneol, while both Red-Blue and RGB SCL increased concentrations of cis-nerolidol compared to the control treatment. In the upper canopy, concentrations of α-pinine, limonene, myrcene, and linalool were significantly greater with RGB SCL than the control, and cis-nerolidol concentration was significantly greater in both Red-Blue and RGB SCL treated plants relative to the control. Red-Blue SCL yielded a consistently more stable metabolome profile between the upper and lower canopy than RGB or control treated plants, which had significant variation in cannabigerolic acid (CBGA) concentrations between the upper and lower canopies. Overall, both Red-Blue and RGB SCL treatments significantly increased yield over the control treatment, RGB SCL had the greatest impact on modifying terpene content, and Red-Blue produced a more homogenous bud cannabinoid and terpene profile throughout the canopy. These findings will help to inform growers in selecting a production light quality to best help them meet their specific production goals.

NOTES

Oral – Abstract #130

Lessons Learned from Large Scale Greenhouse Production of Medical Cannabis

Matt Rogge[*1]

[1]7ACRES/Supreme Cannabis Company

matt.rogge@7acres.com

It is an exciting time in the industry to be a scaled cultivator of cannabis – there has never been more technology and funding available to producers for the optimization of cannabis cultivation. Company's are rapidly scaling up and there are many divergent thoughts on the optimal way to produce dried cannabis flower. It appears for every successful innovation, there is an equal or greater number of salespeople peddling snake oil. With the lack of published data for cannabis relative to existing greenhouse crops, and limited number of established industry best practises, it is easy to understand why cultivators are led astray. I will leverage my experience gained from my integral role in the initiation of cultivation systems at 7ACRES, an industry leading producer of premium cannabis at commercial scale, to discuss important aspects of cannabis cultivation at large scale.

- Production Management for Large Scale
    - Clearly defined business objectives and linked cultivation methodology
    - Production space allocation (and auxiliary functions)
    - Building cultivation processes and systems
    - Team building and culture
    - Scheduling
    - Change control process
    - Lot sizes and cultivars
    - Sourcing materials / vendors
- Mitigating risk in Production Design
    - Modular design approach
    - Personnel and process flow
    - Regulator management
    - Cognizant of business model for design
    - Construction process management
- Cultivar Selection for Commercial Applications
    - Scoping cultivars for cultivation methodology
    - sourcing starting materials in ACMPR
    - selection and R&D activities in a commercial production environment

- IPM in a restrictive, scaled monoculture environment
    - Evolving legislation regarding control products
    - Scaled monoculture production strategies
    - IPM foresight in design process and system engineering
- Data management and evaluation
    - Record keeping
    - Climate control
    - Grower feedback
    - Accessibility
- Industry Awareness
    - Leveraging consultants with proven track records
    - Establishing informal working groups
    - Perspective through site visits

NOTES

Poster – Abstract #216

Assessing a novel nutrient delivery strategy for commercial production of subirrigated chrysanthemums

Barry J. Shelp*[1], William J. Sutton[1], Lou Schenck[2], Jamie Aalbers[2]

[1]Department of Plant Agriculture, University of Guelph, Guelph, Ontario, Canada N1G 2W1; [2]Schenck Farms and Greenhouses, St. Catharines, Ontario, Canada L2R 6P9. bshelp@uoguelph.ca

Greenhouse floriculture operations can pose significant environmental risk due to the extensive use of fertilizer inputs. The aim of our research is to optimize nutrient delivery so that less fertilizer is used over the entire crop cycle. Recently, we reported on a novel nutrient delivery strategy for subirrigated, potted, disbudded chrysanthemums, wherein constant low levels of N, P or S are provided during vegetative growth only, without negative effects on plant yield and quality of the fully-opened inflorescence. Here, a trial was conducted in a commercial greenhouse to characterize the response of four subirrigated, potted, pinched chrysanthemum cultivars to a constant low level of N/P/K supplied continuously over the crop cycle (T1 = 10.7/1.9/8.2 mM ≡ 150/59/322 ppm) or interrupted at inflorescence emergence (T2 = 10.7/1.9/8.2 mM and T3 = 5.35/0.95/4.10 mM). The dry mass yields of T3 plants for all four cultivars at commercial harvest (~90% of the inflorescences were partly opened) were reduced by only 7-12% compared to the T2 plants, and visible symptoms of nutrient deficiency were absent. These findings were generally associated with lower tissue levels of N, P and K than in the T2 plants over the entire crop cycle, but only the tissue-P at flowering was slightly below the limit considered acceptable in the scientific literature. Our combination of research and commercial trials indicates that N, P, K and S supplies for subirrigated chrysanthemums can be reduced by 75% or more, compared to typical commercial recommendations, without adverse effects on marketable quality.

Poster – Abstract #229

Optimizing sulphur delivery for subirrigated chrysanthemums

William J. Sutton[1]**, Gale G. Bozzo[1], William N. Macdonald[2], Chevonne Carlow[3], Barry J. Shelp[1]

[1]Department of Plant Agriculture, University of Guelph, Guelph, Ontario, Canada N1G 2W1.
[2]Niagara College Canada, Niagara-on-the-Lake, ON L0S 1J0. [3]Ontario Ministry of Agriculture, Food & Rural Affairs, Vineland Station, ON L0R 2E0. wsutton@uooguelph.ca

Standard nutrient solutions for greenhouse floriculture typically supply nutrients in excess of the plant's requirements, which results in low nutrient use efficiency and waste of nutrients. Here, we tested the hypothesis that sulphur (S) use efficiency of subirrigated chrysanthemums is improved by delivering constant low levels of S during vegetative growth, and then interrupting the supply during reproductive growth, without sacrificing plant yield and quality. A balanced split-plot experiment was conducted using disbudded potted chrysanthemums grown under greenhouse conditions with S treatment (2.25 mM or 72 ppm supplied continuously over the crop cycle or 2.25, 1.125 and 0.5625 mM S suppled during vegetative growth only) as the main plot and cultivar ('Olympia' and 'Covington') as the sub-plot, and the main plots were arranged as a randomized complete block design of four blocks. Morphological characteristics of plants with fully-expanded inflorescences were unaffected by the S treatments, and visible symptoms of S deficiency were absent. Construction of S and dry mass budgets revealed that S use efficiency (shoot dry mass / S supply or shoot uptake) and S uptake efficiency (shoot S content / S supply or pot uptake) increased significantly in both cultivars with decreasing S supply over the crop cycle. This study indicates that a low constant level of S delivered over the vegetative period only, is sufficient for the production of marketable chrysanthemums grown with subirrigation, and suggests that the S supply over the crop cycle can be reduced by at least 75%, compared to typical commercial recommendations.

FRUIT SYMPOSIUM

FRIDAY OCTOBER 5. Location: Salon A (3rd Floor), Marriott on the Falls

Friday October 5				
8:00 AM	8:50 AM	Registration desk open, located outside of Salon A (3rd floor)		
8:50 AM	9:00 AM	Opening Remarks, Housekeeping announcements	Dr. Jay Subramanian	Welcome remarks to the Fruit symposium and introduction of co-chairs
9:00 AM			Viticulture Session	Session Chair: Dr. Andy Reynolds
9:00 AM	9:35 AM	Speaker 1-Invited	Dr. Imed Dami	Cold Hardiness of Grapevines: Recent Advances in Improvement and Management
9:35 AM	10:10 AM	Speaker 2	Dr. Simone Castellarin	Deficit Irrigation Affects the Concentration of Terpenes in Gewürztraminer Grapes
10:10 AM	10:30 AM	Speaker 3	Ms. Yifan Yan	Different Day- and Night-Temperature Regimes Affect the Accumulation of Flavonoids in Grapevine
10:30 AM	11:00 AM	Refreshment break		
11:00 AM	11:20 AM	Speaker 4	Dr. Junfung Wang	Hormone Application Strategies for Improving Terpene Accumulation in Gewürztraminer Berries
11:25 AM	11:45 AM	Speaker 5	Mr. Christoph Kessel	Potassium fixation and availability in the dominant vineyard soils of the Niagara Region to improve soil potassium fertilizer application guidelines
11:45 AM	12:00 PM			General Discussions on Viticuture Session
12:00 PM	1:30 PM	LUNCH	Oakes Grand Ballroom North (2nd floor, Mezzanine)	
1:30 PM			Tree Fruits Session	Session Chair: Dr. Jay Subramanian
1:30 PM	2:10 PM	Speaker 6-Invited	Dr. Kenong Xu	Towards a comprehensive understanding of apple tree architecture
2:15 PM	2:35 PM	Speaker 7	Dr. Mukund Shukla	Micropropagation: Relevance to Ontario Agriculture
2:40 PM	3:00 PM	Speaker 8	Ms. Erika Debrouwer	Mitigation of fruit drop and prolonging of postharvest shelf life in 'Honeycrisp' apples using hexanal
3:00 PM	3:30 PM	Refreshment Break		
3:30 PM			Tree Fruits and Berries	Session Chair: Dr. Samir Debnath
3:30 PM	3:50 PM	Speaker 9	Dr. Jay Subramanian	Breeding to postharvest: Recent advances in Ontario Stone Fruit Industry
3:55 PM	4:30 PM	Speaker 10	Dr. Samir Debnath	Epigenetic variation in small fruit tissue culture plants
4:35 PM	5:00 PM	Speaker 11	Mr. Varindher Sidhu	Low Nitrogen Supply with Extended Photoperiod Induces Flowering in Day neutral Strawberry
5:10 PM		Bus to Butterfly Conservatory		
5:30 PM	6:15 PM	Butterfly Conservatory	Bus to banquet	
6:30 PM		BANQUET	Benchmark Restaurant, 135 Taylor Rd., Niagara-on-the-Lake	

*Presenter **CSHS student to be evaluated for a Presentation Award

Invited Oral – Abstract #8

Cold Hardiness of Grapevines: Recent Advances in Improvement and Management

Imed Dami*[1]

[1]Horticulture and Crop Science, College of Food, Agricultural, and Environmental Sciences, The Ohio State University, Columbus, OH 43210.

dami.1@osu.edu

Cold damage is the most limiting factor of grape production in northern latitude regions of the US and Canada. Grapevines have developed mechanisms to cope with freezing stress, but their genetic make-up may limit the cold hardiness potential such as with all varieties of *Vitis vinifera.* Recent advances in applied research of cold protection and management of grapevines after winter injury will be presented.

NOTES

Oral – Abstract #103

Deficit Irrigation Affects the Concentration of Terpenes in Gewürztraminer Grapes

Yevgen Kovalenko[1] and **Simone Diego Castellarin*[1]**

[1]Wine Research Centre, 2205 East Mall, University of British Columbia, Vancouver, BC V6T 1Z4.

simone.castellarin@ubc.ca

Deficit irrigation is a viticultural practice often applied to red grape varieties to improve grape and wine quality. However, the impact of this practice on the quality of white grapes and wines remains largely unknown. In a field study conducted in Oliver, BC, in 2016 and 2017, deficit irrigation regimes were applied to Gewürztraminer vines at different developmental stages (pre-veraison = Early Deficit, ED; post-veraison = Late Deficit, LD; throughout the season = Prolonged Deficit, PD). Treatments were replicated four times accordingly to a randomized block design. The treatment impact on vine physiology and berry metabolism was characterized with eco-physiological, biochemical, and molecular analyses. Starting three weeks after fruit set, midday leaf water potential was measured every 7-14 days and leaf gas exchanges every 14-21 days. Berry sampling was conducted every 7-14 days. Midday leaf water potential, photosynthesis, and transpiration rates were reduced by deficit irrigation. ED, LD, and PD reduced vine yield but LD reduction was marginal. No difference in sugar levels was observed among treatments at harvest. Free terpenes were quantified through SPME-GC-MS. Total free terpenes did not change among treatments in both seasons. However, some free terpenes such as β-citronellol, citral, geraniol, and geranic acid were increased by LD, particularly in 2016. The expression of terpene genes (e.g., Vvi DXSs, VviHDR, VviTPSs, VviMyb24) was assessed. LD berries did not display higher level of expression, suggestion that the observed increase in the concentration of free terpenes was not regulated at the transcriptional level.

NOTES

Oral – Abstract #105

Different Day- and Night-Temperature Regimes Affect the Accumulation of Flavonoids in Grapevine

Yifan Yan[1]**, Changzheng Song[1], Junfang Wang[1], Simone Diego Castellarin[1]
[1]Wine Research Centre, The University of British Columbia, 2205 East Mall, Vancouver, BC V6T 1Z4, Canada.

evelineyan@foxmail.com

Flavonoids are a variety of compounds that include anthocyanins, flavonols, flavan-3-ols and proanthocyanidins (tannins) and are accumulated in grape berry during development and ripening. Flavonoids strongly affect red wine quality by determining wine pigmentation, bitterness, astringency, and health benefits. Flavonoid accumulation is very sensitive to temperature; however, the relationship between day- and night-time temperature regimes and the mechanism of flavonoid biosynthesis in grapes is still poorly understood. We conducted a growth chamber experiment where the effect of temperature regimes on berry flavonoids was assessed. Merlot grapevines were subjected to 20 ℃ and 10 ℃, 20 ℃ and 15 ℃, 25 ℃ and 15 ℃, 35 ℃ and 25 ℃, and 35 ℃ and 30 ℃ of day (D)- and night (N)-time temperature, respectively. Generally, low temperature regimes (D20N10, D20N15) accumulated the highest anthocyanin and flavonol amount in the berry. Grape berries under medium temperature regime (D25N15) accumulated intermediate anthocyanin and flavonol levels, while grapes under high temperature regimes (D35N25, D35N30) had the lowest levels of anthocyanin and flavonols in the berry. Interestingly, high temperature regimes accumulated higher proportion of tri-hydroxylated and methoxylated flavonoids but lower proportion of di-hydroxylated flavonoids. Molecular analysis revealed that differences in anthocyanin levels were modulated by the expression level of *VviUFGT* and *VviMybA*. An increased *VviF3'5'H* : *VviF3'H* expression ratio was observed in berries exposed to high temperatures, consistently with the highest tri- : di-hydroxylated anthocyanin ratio observed. These results provide new insights on the optimal temperature regime for the accumulation of flavonoids in red grapes.

NOTES

Oral – Abstract #106

Hormone Application Strategies for Improving Terpene Accumulation in Gewürztraminer Berries

Junfang Wang*[1] and Simone Diego Castellarin[1]

[1]Wine Research Centre, The University of British Columbia, 2205 East Mall, Vancouver, BC V6T 1Z4, Canada.

jfwang0306@gmail.com

Vancouver Island and the Gulf Islands are two major wine regions in British Columbia. However, in cooler years, fruit ripening can be slow and the achievement of optimum grape quality challenging. The control of fruit ripening and the intricate network of interactions among hormones are still largely unknown in the grape berry - a non climacteric fruit. The aim of this project is to investigate how the exogenous applications of hormones (abscisic acid, ABA; jasmonic acid, JA; ethylene, ETH; auxins, IAA and NAA) related to berry ripening affects the accumulation of terpenes - the major aromatics in Gewürztraminer berries. Pre-veraison clusters were sprayed three times with hormone solutions at the onset of ripening. The major ripening-related indices (sugars, titratable acidity, pH), flavonols, anthocyanins, and free and glycosylated terpenes, as well as the expression of key terpene genes were analysed. Exogenous hormones increased berry terpenes at harvest. The JA treatment stimulated the highest accumulation of terpenes. Terpene synthases (VviTPS10, VviTPS34/35) responsible for the production of a monoterpene (ocimene) and a sesquiterpene (α- farnesene) increased in expression under hormone treatments, consistently with the observed increase in metabolite concentration in the same berries. A transcription factor (VviMyb24) putatively involved in terpene biosynthesis also showed a consistent expression pattern with the ones of VviTPS10 and VviTPS34/35. This knowledge will help optimize the quality of white grapes in Vancouver Island and Gulf Islands by providing new potential viticultural strategies for modulating aromatics accumulation in vineyards.

NOTES

Oral – Abstract #109

Potassium fixation and availability in the dominant vineyard soils of the Niagara Region to improve soil potassium fertilizer application guidelines

Christoph Kessel*[1], Richard Heck[2], Kathryn Carter[3]

[1]Ontario Ministry of Agriculture, Food and Rural Affairs;
[2]School of Environmental Sciences, University of Guelph;
[3]Ontario Ministry of Agriculture, Food and Rural Affairs.

christoph.kessel@ontario.ca

Ontario Ministry of Agriculture, Food and Rural Affairs has potassium fertilizer guidelines based on ammonium acetate extractable soil test potassium for establishing new vineyards but not for established vineyards. Consequently, potassium management decisions for established vineyards are made by combining potassium soil tests with annual petiole analysis (taken mid-August to mid-September). Improved potassium management decisions could be arrived at through a better understanding of a soil-landscape model using soil survey information, the relationships between soil properties, soil test potassium, the soil's potassium supplying ability and annual petiole analysis. From 2012-14, 146 co-operator vineyard sites were selected in the Niagara Appellation Region based on targeted soil series and cultivars. These sites represented up to 4 soil catenae and where possible 3 drainage regimes (well, imperfect and poor). Soil samples were taken at 2 depths (0-15 and 15-30 cm). Soils were analyzed for pH, organic matter, extractable phosphorus, potassium, magnesium and calcium, as well as cation exchange capacity, texture, and potassium adsorption and fixation. Petioles were also collected and analyzed for these sites. Results indicated that although the relationship between soil test and percent petiole potassium was weak, it could be improved by taking soil samples at 0-15 and 15-30 cm depths and also considering soil texture (coarse, medium and fine) and drainage regimes.

NOTES

Invited Oral – Abstract #9

Towards a comprehensive understanding of apple tree architecture

Kenong Xu*[1], Laura Dougherty[1], Raksha Singh[1] and Susan Brown[1]

[1]Horticulture Section School of Integrative Plant Science Cornell University NYS Agricultural Experiment Station 630 W. North St. Geneva, NY 14456.

kx27@cornell.edu

The Green Revolution is a well-known term that primarily describes the landmark accomplishments in genetic improvement of plant architecture in the 1960s and 1970s, which led to a drastic yield increase for maize, rice and wheat. To keep trees in optimal shape for fruit production, dwarfing rootstocks and various tree training systems have been developed. However, most routine tasks such as tree pruning and fruit harvesting still are being conducted manually due to complex tree architecture. Rising production costs and worsening availability of seasonal farm workers have driven an ever strong demand for mechanization of such orchard routines. Although important progress has been made, the highly variable and complex tree canopy remains a major challenge in large-scale orchard mechanization. Developing apple cultivars that naturally grow as a simple canopy will greatly aid orchard mechanization. To this end, we have been investigating columnar, weeping, and dwarf apple tree forms to uncover the genes and gene networks that are responsible for their unique tree growth characteristics. Our existing data indicate that each of the tree architectural forms, including columnar that was originally discovered as a somatic mutation from 'McIntosh', are controlled by multiple genomic regions and genes, representing an important step forward for comprehending and improving apple tree architecture. Since our efforts are ongoing, the latest results will be presented and discussed.

NOTES

Oral – Abstract #102

Micropropagation: Relevance to Ontario Agriculture

Mukund R. Shukla*[1] and Praveen K. Saxena[1]

[1]Gosling Research Institute for Plant Preservation (GRIPP), Department of Plant Agriculture, University of Guelph, Guelph, ON N1G 2W1.

mshukla@uoguelph.ca

Most vegetatively-propagated crops grown in Ontario are currently imported from the USA and Europe, with only a limited number of plants produced by the Canadian horticultural industry. The conventional approach to propagate plants, including tree fruit varieties and rootstocks, through stem cuttings is a slow process and is unable to meet the current demand for plants. *In vitro* technologies such as micropropagation can be used to multiply plants in large numbers from an existing, limited population to distribute plants with greater expediency. Micropropagation allows plants to be multiplied exponentially in a short time and since they are grown in aseptic culture conditions, plants are healthy and genetically uniform. Efficient protocols for large-scale micropropagation of a range of species of commercial importance such as apple, hazelnut, and hops using the liquid-based bioreactor systems have been developed at the Gosling Research Institute for Plant Preservation (GRIPP). This system facilitates rapid, large-scale multiplication of healthy plants at reduced production costs and with ease of scheduling delivery at specific times of the year. Micropropagation protocols require optimization of in vitro growth conditions such as the composition of nutrient medium, plant growth regulator supplements, and culture environment. Plants produced through our Integrated Plant Production Technology have been successfully transferred to multiple field locations in Southern Ontario where they survived highly efficiently, and significantly better growth compared to the plants propagated via conventional methods. As such, these results highlight the enormous potential of a domestic micropropagation industry for advancing the growth of the Ontario Agriculture.

NOTES

Oral – Abstract #129

Mitigation of fruit drop and prolonging of postharvest shelf life in 'Honeycrisp' apples using hexanal

Debrouwer, Erika J.[1]**, Sullivan, J.A.[2], Paliyath, G.[2], Subramanian, J.[1]

[1] Department of Plant Agriculture, University of Guelph, Vineland Ontario L0R 1E0.
[2] Department of Plant Agriculture, University of Guelph, Guelph Ontario, N1G 2T8.

edebrouw@uoguelph.ca

'Honeycrisp' apples are in high demand, yet obstacles occur with growing and storing this variety. One obstacle is the postharvest disorder known as bitter pit [BP], which can cause a yield loss of 50%, rendering apples unmarketable. Preharvest fruit drop, and degradation of desirable qualities, such as texture, taste and aroma during extended periods in storage are problems that apple growers face. One technology to combat these challenges is hexanal, a natural compound that is currently being used in the Enhanced Freshness Formulation (EFF). EFF has shown to increase postharvest shelf life, maintain quality parameters and decrease fruit drop, including mango and nectarine, by delaying the breakdown of the membrane. Hexanal slows cell degradation through inhibition of phospholipase-D (PLD). PLD is an enzyme that initiates autocatalytic reactions, assisting in the degradation of lipids, leading to ripening and softening of the cell membrane. Three treatments, (1) EFF, (2) EFF without hexanal [EFF w/o H] and (3) EFF with calcium chloride [EFF w C] applied to 'Honeycrisp' apples were assessed on various quality measurements; such as, colour, firmness, total soluble solids, titratable acidity, along with marketability regarding BP incidence. Total soluble solids showed significant differences between the EFF w/o H and EFF w C treatments, along with significant differences between the EFF and EFF w/ C treatments. Significant differences were also seen between all treatments in marketability. In assessing these components, we hope to increase the longevity, raise marketability, and maintain palatability of 'Honeycrisp' apples, while also determining genes influenced by hexanal.

NOTES

Oral – Abstract #107

Breeding to postharvest: Recent advances in Ontario Stone Fruit Industry

Jayasankar Subramanian*[1], G Paliyath[1] and J Alan Sullivan[1]

[1]Department of Plant Agriculture, University of Guelph, Guelph, Ontario, Canada, N1G 2W1.

jsubrama@uoguelph.ca

Stone fruit breeding has been in progress at Vineland for over 75 years. Several improved varieties to fit the Canadian conditions have been developed from this place. Fruit quality is of importance to all the stakeholders in the value chain. Traditionally, fruit production and quality has been addressed through a combination of genetics and management, of late more importance is given to breeding fruits that can also have a good post harvest shelf life. Each fruit has its own problems to be addressed e.g. mealiness in peach and nectarine. Recent advances made in both breeding as well as post-harvest to improve quality of stone fruits will be discussed.

NOTES

Oral – Abstract #121

Epigenetic variation in small fruit tissue culture plants

Samir Debnath*[1]

[1]St. John's Research and Development Centre, Agriculture and Agri-Food Canada, NL

samir.debnath@agr.gc.ca

Blueberry, cranberry, grape, raspberry and strawberry, also known as berry crops, are commercially important small fruit crops grown widely across the world. Their superior health-promoting dietary role led the dramatic increase of their global production. Although significant progress has been achieved in berry crop micropropagation using semi-solid gelled and liquid media, *in vitro* culture-derived variation (somaclonal variation) is of significant importance in commercial micropropagation. Variation in tissue culture plants can be due to genetic (heritable) or epigenetic (non-heritable) changes or a combination of both. While the former can arise by mutation at chromosome and/or gene levels, the later involves insertion, excision or activation of transposable elements, DNA methylation and/or segregation of pre-existing chimera tissue. In vitro-derived epigenetic variation plays significant role in small fruit crop production and improvement through juvenile branching characteristics of tissue culture plants leading to the enhanced vegetative growth with more crown, runners, rhizomes, leaf and/or berry production. The present paper describes the progress in depth of various aspects of epigenetic variations in tissue culture plants of small fruit crops.

NOTES

Oral – Abstract #127

Low Nitrogen Supply with Extended Photoperiod Induces Flowering in Day neutral Strawberry

Varinder Sidhu[1]**, V. Bernier-English[2], M. Marel[2] and V. Gravel[1]

[1]Department of Plant Science, McGill University, Ste-Anne-de-Bellevue, QC, Canada.
[2]Ferme Onésime Pouliot Inc., St-Jean-de-l'Île-d'Orléans, QC, Canada.

varinder.sidhu@mail.mcgill.ca

Light and nutrients are among the main factors controlling the plant flowering time, growth and fruit production. While the photoperiod and nitrogen (N) control of flowering have been extensively studied in short day (SD) strawberry cultivars, little is known about the influence of these treatments on flowering behavior of day neutral (DN) strawberries, despite their rising popularity within the industry. The objective of this experiment was to determine the optimal photoperiod to promote flower bud induction (FBI) during transplant production and how N concentration regulates FBI, morphology and fruit yield in relation to contrasting photoperiods in DN cultivated strawberry (*Fragaria ananassa* cv. 'Albion'). Results showed that a 15h-photoperiod supplemented with candescent light produced a maximum number of flower stalks and correspondingly, produced 6% higher fruit yield compared to natural light, however differences were not statistically significant. Interestingly, 25% N produced significantly ($p<0.05$) more flower stalks compared to 50% and 100% N. In terms of fruit yield, 25% N and 100%N produced comparable results, although significantly different from 50%N treatment. Additionally, it was observed that plants treated with supplemented photoperiod and 25%N produced excessive vegetative growth i.e. runners and leaves. This study suggested that advanced FBI and higher fruit yield can be achieved for DNs by supplying low N and extending the photoperiod during transplant production, however, light quality may influence the results.

NOTES

Poster – Abstract #202

Applying Molecular Tools for Identification of Black Knot Resistance Gene(s) in Plum (*Prunus domestica* L. and *Prunus salicina* Lindl.) Cultivars

Ranjeet Shinde[1]**, Walid El Kayal[1], Wendy McFadden-Smith[2], Jayasankar Subramanian[1]

[1]Department of Plant Agriculture, University of Guelph, 50 Stone Road East, Guelph, Ontario, N1G 2W1, Canada; [2]Ontario Ministry of Agriculture, Food and Rural Affairs. rshinde@uoguelph.ca

Black knot (BK), caused by the fungus *Apiosporina morbosa* is an important disease of plum trees in North America, which causes trees to lose vigor by causing deformation and girdling of branches and become increasingly susceptible to winter injury. Current management strategies, including fungicide application and pruning of infected branches, are largely inefficient due to the long life cycle of the fungus and its capacity to avoid detection until it sets well. Therefore, the development and use of resistant cultivars are warranted. The main objective of the current project is to investigate the genetic basis underlying BK resistance in European (*Prunus domestica* L.) and Japanese (*Prunus salicina* Lindl.) plums. Approximately, 350 European and 200 Japanese plum genotypes have been phenotyped for BK resistance. Using this information, a select subset of resistant and susceptible Japanese and European plum cu ltivars are identified. These select subset consisting of extremely contrast genotypes will be used for RNA sequencing to identify BK resistance gene(s) and genome-wide marker-trait association. Further, histology of plum tissues affected by BK has revealed interesting information about the internal spread of the fungus suggesting that the disease can be spread through tools as well. Identified markers and gene(s) will be useful for large-scale genomic selection and development of BK resistant cultivars.

Poster – Abstract #207

Fruit and vegetable low light tolerant crops for greenhouse under canopy and windowsill gardening

M.P.M. Nair*[1] and Karen Tanino[2]

[1]LLT Plants® Inc.; [2]Dept. Plant Sciences, University of Saskatchewan, SK, S7N 5A8. lltplants@outlook.com

Food insecurity has created a demand for crops exhibiting high yields under reduced inputs, such as light. Over 55 crops/cultivars were screened for growth under Low Light (LL) at the Agriculture Greenhouses, University of Saskatchewan. This project identified promising plants and evaluated them at a commercial greenhouse. Cool temperature adapted *Brassica japonica* cv. 'Kyoto' mizuna showed highest potential for immediate commercial adoption: a) productively used wasted shaded space between tomato plants, b) can be repeat-harvested over time, c) can simply be added to existing salads, pastas, dishes by chefs for diversified fresh flavour, d) needs no additional care with no apparent pests, e) germinates and grows under cool temperatures of January/February, f) has a more consistent biomass within a row/block than Amaranthus, likely a result of greater tolerance to variations in light levels. Homeowners are less focussed on uniform, high productivity. Thus, the following are also recommended for indoor windowsills: *Brassica rapa* ssp. narinosa ('Tatsoi'), *Perilla frutescens* 'Crispa' (Shiso), tomato (*Lycopersicon esculentum* 'Donna' and 'Heartbreaker'), Thai red and 'Pink Ruby' *Amaranthus*. *Amaranthus* red and 'Pink Ruby' varieties were equally productive under sun and shade (135 $\mu molm^{-2}s^{-1}$) despite a 80% reduction in light intensity. A simple Fv/Fm measurement reflected lettuce cultivar productivity under HL and LL. Also after 38 years of breeding, a LL tolerant lemon and lime have CFIA-approval: 'First Canadian' lemon and 'First Canadian Golden' lime. Some of these new citrus plants are producing up to 12 - 15 commercial size lemon fruit/plant in a 15-cm pot on the windowsill.

Poster – Abstract #211

Biological Control of Strawberry *Anthracnose* Using *Trichoderma harzanium*, *Streptomyces lydicus*, and *Bacillus subtilis*

Zahra Charkhzarrin[1]**, Hervé Van der Heyden[2], Valérie Gravel[1]

[1]Department of Plant Science, McGill University, Ste-Anne-de-Bellevue (Quebec), Canada, H9X 3V9;
[2]Phytodata Inc, Saint-Édouard (Quebec), Canada, J0L 1Y0. zahra.charkhzarrin@mail.mcgill.ca

Strawberry is an important high demand fruit known as a good source of crucial vitamins and minerals. The province of Quebec produces 48% of the strawberry in Canada. Anthracnose, caused by *Colletotrichum acutatum*, is among the major fungal diseases of strawberry worldwide and has raised concerns in Canada. Despite high demand for organic fruits, chemical fungicides still play a major role in management of this disease. Therefore, creating an Integrated Pest Management (IPM) method and shifting to biofungicides is necessary to reduce the use of chemical fungicides. Due to latent infection and invisible symptoms in the early stages of this disease, finding an optimal time to apply the biofungicide only based on visible symptoms is not feasible. This study aims to find the optimal application time of three biofungicides (*Trichoderma harzanium*, *Streptomyces lydicus*, and *Bacillus subtilis*) based on inoculum density, to effectively control anthracnose on day-neutral strawberries. Strawberry plants were inoculated and samples from crown, runner, petiole, and leaves were taken at key stages of the plants' development. Pathogen inoculum density was measured through real-time PCR and the biofungicides were applied at three different levels; 0, 30 and 100µg of *C. acutatum* DNA/100mg of plant tissue. Afterwards, inoculum density was continuously monitored to correlate it with disease symptoms, plant physiological development, and fruit yield. Monitoring inoculum density has proven to be an efficient tool in managing anthracnose disease of strawberry plants.

Poster – Abstract #212

Effective control of plant parasitic nematodes using drip-line applications of fumigant and nematicide in raspberry and strawberry

Eric Gerbrandt*[1]

[1]Raspberry Industry Development Council ericgerbrandt@hotmail.com

Poor replant success is an important limitation to competitiveness for commercial raspberry growers in Canada's largest production region in the Fraser Valley, British Columbia. While Phytophthora root rot and other factors play roles in many fields, high populations of plant parasitic nematodes (PPN), especially the root lesion nematode (*Pratylenchus penetrans*), contribute to poor plant establishment. The same is true for day-neutral strawberry plantings. To advance production practices for commercial growers, four replicated blocks were used to compare combinations of pre-plant fumigant and post-plant nematicide applications in new plantings of 'Meeker' raspberry and 'Albion' strawberry in 2017 and 2018. As a main-plot treatment, drip-line applications of pre-plant fumigant (Vapam) were compared with a non-fumigated control under a black plastic mulch. These applications have the potential to substantially decrease the amount of fumigant used when compared with broad-cast applications, reducing production costs and buffer zone requirements. As a split-plot treatment, post-plant nematicides (Velum Prime, Nimitz and Vydate) were compared under fumigated and non-fumigated conditions. Plant growth and fruit yield were evaluated, and PPN populations were determined at three times during 2017 and 2018. The potential for sustained control of PPN populations was determined, and the benefit to plant establishment and productivity were evaluated to provide growers with information that can be used to direct field management practices.

Poster – Abstract #217

Predatory bugs *Nabis americoferus* and *Orius insidiosus* as potential biological control agents of *Lygus lineolaris* in organic strawberry fields

Francois Dumont*[1], Caroline Provost[1] Eric Lucas[2]
[1]Centre de recherche agroalimentaire de Mirabel; [2]Université du Québec, Montréal.
fdumont@cram-mirabel.com

The tarnished plant bug *Lygus lineolaris* (Palisot de Beauvois) (Hemiptera: Miridae) is the main barrier preventing conventional strawberry growers from adopting organic management. This major pest feeds on more than 120 economically important plants (e.g. alfalfa, soybeans, apples, mustards, buckwheat). The TPB has several predators that can reduce its density in agroecosystems (e.g. predatory bugs, ladybeetles, spiders) and their role as biological control agents of the TPB has been overlooked for a couple reasons. Namely, the high reproduction rate of the TPB and the timeline available to observe predatory effects as the presence of few TPB can cause high economic damage in a short period of time. In a recent study on the effect of trap crops on TPB in strawberry fields, we observed that both the damsel bug *Nabis americoferus* (Carayon) (Hemiptera: Nabidae) and the minute pirate bug *Orius insidiosus* (Say) (Hemiptera: Anthocoridae) naturally colonize plots exploited by the TPB and are suspected to be the main contributors to the TPB's mortality (about 50% from large nymphs to adults). The aim of this project is to determine the potential of both *N. americoferus* and *O. insidiosus* bugs against the TPB and optimize their role in organic strawberry fields. Preliminary results on the level of predation and prey preferences of both predators and intraguild predation will be presented. The results of this study will also be included in an integrated pest management program in the hopes of reducing pesticides used to control the TPB.

Poster – Abstract #218

Wild blueberry: disease incidence in different management zones

Julie Lajeunesse*[1], Jean Lafond[1], Athyna N. Cambouris[2] and Isabelle Perron[2]
[1]Agriculture and Agri-Food Canada, Normandin Research Farm, 1468 Saint-Cyrille St., Normandin, QC, G8M 4K3; [2]Agriculture and Agri-Food Canada. julie.lajeunesse@agr.gc.ca

Lowbush blueberry, grown in a 2-year cycle (vegetative and production), is a major crop in the Saguenay-Lac-Saint-Jean area (Quebec) where the production represents more than 85% of the entire blueberry harvested in the province of Quebec. There are three major diseases that affect lowbush blueberry: septoria (*Septoria* spp.) and *Valdensinia* leaf spot (*Valdensinia heterodoxa*), and monilinia blight (*Monilinia vaccinia-corymbosi*). Prothioconazole is usually applied during the vegetative year to control diseases. In 2016, two fields were selected near Normandin (Quebec) and four different management zones were determined according to apparent soil electrical conductivity and elevation in each field. In each of these zones, in 2017 (vegetative year), four N fertilisation rates (0, 30, 60, 90 kg N ha-1) with or without prothioconazole (192 g a.i. ha-1) were applied in a split-plot design, where the main plot wa s the N fertilisation rates and the subplot was fungicide. The objective was to determine if N fertilisation and the application of fungicide could affect the incidence of the three diseases. *Septoria* and *Valdensinia* incidence was rated on five plants per plot that were randomly identified at the beginning of the season. On each of these plants the five youngest leaves were used to assess the disease severity index (DSI). In 2017, the incidence of *Septoria* leaf spot was very low and there were no *Valdensinia* leaf spot. Nitrogen rate and fungicide had no effect on disease incidence or DSI. In 2018, *Monilinia* blight will also be rated and results will also be presented.

Poster – Abstract #221

Changes of total phenolic and flavonoid contents and antioxidant activity during somatic embryogenesis in lowbush blueberry wild clones.

Amrita Ghosh[1,2], Abir U. Igamberdiev[1] and **Samir C. Debnath*[2]**

[1]Department of Biology, Memorial University of Newfoundland, St. John's, Newfoundland and Labrador, Canada; [2]St. John's Research and development Centre, Agriculture and Agri-Food Canada, St. John's, Newfoundland and Labrador, Canada. samir.debnath@agr.gc.ca

Phenolic compounds considered as an important group of secondary metabolites; widely distributed in plant genera. Research has shown that blueberries are high in health-promoting phytochemicals exhibiting high antioxidant activities by scavenging free radicals. There are overwhelming evidences available showing free radicle cause cancer, cardiovascular and neurodegenerative diseases. Therefore antioxidants, which can scavenge free radicals, can be the main factor to cure these diseases. In past few years, studying metabolic pathways of these phytochemicals with antioxidant activities has become the main area of bio-medical research. The main purpose of this study is to quantify the phytochemical components such as the total phenolic (TPC) and -flavonoid contents (TFC), and antioxidant activity (AA) of two lowbush blueberry *(V. angustifolium* Ait.) wild clones designated as 'CL1' and 'CL2' from the plants regenerated via somatic embryogenesis and conventionally grown counterparts. The chemical analysis has been done on the crude extracts obtained from 6 – 8 week-old leaves. The highest level of antioxidant activity was detected in the conventionally cutting (CC) donor plants as compared to the somatic embryogenesis (SE) regenerated plants in both clones. TPC and TFC were present comparatively in higher amounts in SE than in CC donor plants. We also observed that considerable variability exists between the genotypes in terms of antioxidant properties. These results clearly point out the effect of somatic embryogenesis process on TPC, TFC and antioxidant activities in lowbush blueberry wild clones.

Poster – Abstract #224

Effect of Night Interruption and Light Quality on Flower Bud Induction in Day neutral Strawberry

Varinder Sidhu[1]** and Valerie Gravel[1]

[1]Department of Plant Science, McGill University, Ste-Anne-de-Bellevue, QC, Canada. varinder.sidhu@mail.mcgill.ca

Light quality, referring to wavelength, and photoperiod are key factors that regulates strawberry flower bud initiation at nursery stage. Night interruption (NI), artificial lighting during the dark night period to simulate LD photoperiodic conditions. The objective of this study is to determine the effect of NI and wavelength on day neutral strawberry (*Fragaria ananassa* cv. 'Albion') flower bud induction. In one experiment, transplants were exposed to photoperiods of 10h (SD), 15h (LD), 10h (8h+2NI) and 15h (13h+2NI) using fluorescent lights in growth chambers under controlled conditions (25/20°C and 70% RH). Results showed that plants treated with 13h+2NI significantly increased flower bud induction compared to 8h+2NI. However, there was no significant difference between 10h SD and 15h LD treatments. In another experiment, greenhouse-grown transplants were exposed to 16h-photoperiod of red (645nm) and blue (430nm) light emitting diodes (LEDs) at ratios of 5:1 and 1:5, amber (595nm) LEDs and HPS lamp as a control. Results show that high blue to red ratio (B/R, 5:1) significantly increased flower bud induction compared to low blue to red ratio (B/R, 1:5) and amber light. Interestingly, leaf growth was significantly increased under low blue to red ratio (B/R, 1:5). These studies suggest that NI is an effective technique to promote flowering only under LD photoperiod and that blue light can strongly advance flower bud induction in DN strawberries. Furthermore, NI in combination with blue light could be a successful practice to regulate flowering time in DN strawberry cultivars.

Poster – Abstract #228

Development of Nano-Delivery System for Shelf Life Extension of Fruits

Syndhiya Ranjan[1]**, L.-T. Lim[2], A. Sullivan[1], G. Paliyath[1], J. Subramanian[1]
[1]Department of Plant Agriculture, Ontario Agricultural College, University of Guelph. [2]Department of Food Science, University of Guelph. sranjan@uoguelph.ca

Fruits and vegetables are considered as the mainstream human diet because of its various health benefits. However, the estimated loss of fruits and vegetables is 30-54% worldwide (Singh.V *et al*., 2014), largely due to poor post-harvest management. Several novel postharvest technologies developed in recent years have minimized these losses through increasing the product shelf life. For example, phospholipase D (PLD) inhibition technology has been developed to slow down membrane degradation using hexanal, which is a biologically active C6 aldehyde volatile. This research focuses on developing a method to incorporate hexanal into nanomatrices by using an electrospinning technology. The release of hexanal from the nanomatrix can be triggered by moisture from the air released by fruits within confined environments, such as package headspace. The electrospun fibers are characterized using scanning electron microscopy and the release of hexanal from the nanomatrix is studied using gas chromatography. Shelf life extension can be achieved by exposing fruits and vegetables (bell peppers, pears, plums, peaches, nectarines) to hexanal released from the bioactive nanomatrix in packaging.

Poster – Abstract #230

Impact of grapevine grafting for hybrid varieties grown in Quebec, Canada

Caroline Provost[1]** and François Dumont[1]

[1]Centre de recherche agroalimentaire de Mirabel, 9850 rue Belle-Rivière, Mirabel, QC. Canada, J7N 2X8. cprovost@cram-mirabel.com

Grapevine production is relatively recent in Quebec, Canada, and several challenges restrict quality grape production. Quebec's rigorous climate and short growing season are just a couple of limiting factors in grape production and varietal selection. Rootstocks adapted to growing conditions allow producers to plant varieties that are better adapted and more efficient in specific soil and climatic conditions. Selected scion/rootstock combinations could be better suited to growing conditions found in Quebec vineyards, thereby homogenizing vegetative growth for all vines, reducing costs associated with management and help to reach maturity and optimum berry quality. The main objective of this project was to evaluate the use of grafting as a technique to adapt hybrid vines to cold climate growing conditions found in Quebec, Canada. Several combinations were produced using Frontenac, Frontenac blanc and Marquette cultivars along with 4 rootstocks (101-14 MGT, 3309 R, Riparia Gloire de Montpellier, SO4), as well as own-rooted vines. The experimental plot was implanted in 2013 in gravelly-loam soil. Several parameters were observed, such as yield, berry chemistry and wine sensory analysis. Rootstock effect showed little impact on yield and berry chemistry. However, a significant effect on wine appreciation was noticed, where use of rootstock generally increased wine quality. In Quebec, grafting hybrid cultivars is not a common practice, but it could be profitable to the producer to select rootstocks adapted to their soil and climate conditions in order to improve profitability.

POSTHARVEST STORAGE, PROCESSING AND NUTRACEUTICALS SYMPOSIUM

Location: Hennepin North-South Ballroom

Saturday October 6				
8:30 AM	8:50 AM	Registration desk open	Hallway near Hennepin North-South Ballroom	
8:50 AM	9:00 AM	Opening Remarks	Dr. Gale Bozzo (Chair)	
9:00 AM	9:35 AM	Speaker 1-Invited	Dr. Amit Dhingra	Physiogenomic characterization of a ripening anomaly in *Pyrus communis*: Discovery and application
9:35 AM	10:05 AM	Speaker 2-Invited	Dr. Vasantha Rupasinghe	Nutraceuticals and functional foods from cool climate fruits
10:05 AM	10:35 AM	Speaker 3 -Invited	Dr. Paul Spagnuolo	Avocado bioactives in cancer chemotherapy
10:35 AM	10:45 AM	General Question period		
10:45 AM	11:00 AM	Refreshment Break		
11:00 AM	11:20 AM	Speaker 4	Dr. Amy Bowen	The value of sensory and consumer science in postharvest evaluation of fruits
11:20 AM	11:40 AM	Speaker 5	Dr. Gale Bozzo	Oxidative stress signatures in apple and pear fruit: predictive tools for storage-related disorders
11:40 AM	12:00 PM	Speaker 6	Mr. Robert Brandt	Maintaining the quality of strawberry using post-harvest vapour applications of hexanal
12:00 PM	12:20 PM	Speaker 7	Dr. John Einset	Genome size, x-ray sensitivity and DNA repair in vegetables and trees as model systems
12:20 PM	12:30 PM	General Question Period		
12:30 PM		Student Oral and Poster Session Winners	Dr. Valerie Gravel	
12:40 PM		Closing Remarks	Dr. Karen Tanino	
12:45 PM		LUNCH		Milestones Restaurant, 2nd floor Marriott on the Falls

Invited Oral – Abstract #2

Physiogenomic Characterization of a Ripening Anomaly in *Pyrus communis:* Discovery and Application

Amit Dhingra*[1] Christopher Hendrickson[1], Seanna Hewitt[1]

[1]Department of Horticulture, Washington State University, Pullman, WA 991641.

adhingra@wsu.edu

Climacteric ripening is a well-characterized process during fruit development. Despite an extensive understanding of this process there are variations in the plant kingdom that point towards the existence of novel and complex aspects of this process. European pear (*Pyrus communis* L.) represents one such anomaly where the fruit are harvested at maturity but in an unripe state. Since there is a great level of diversity in the physiological maturity of the fruit, the fruit does not ripen in a synchronized way leaving the customer dissatisfied. Predictable and synchronized ripening can be achieved by proper conditioning or pre-ripening of the fruit, which involves incubating the fruit in a genetically pre-determined amount of cold during postharvest stages. Further, the pear industry has tried to use an ethylene receptor inhibitor, 1-methylcyclopropene (1-MCP) to delay the ripening of the fruit. Unlike in apple, application of 1-MCP results in the pear fruit remaining in a "locked" state in which ripening cannot occur. Utilizing a physiogenomics approach, we identified that the alternate respiratory pathway is activated during pre-climacteric stages as the fruit undergoes cold conditioning. Following up on this information, a chemical genomics approach was used to successfully and consistently ripen 1-MCP treated fruit. We hypothesize that chemical activation of the alternative respiratory pathway activates the TCA cycle leading to the generation of ethylene. We have utilized this recently patented technology to also enable the development of high quality fresh sliced pears, which has the potential to make a large economic impact on the pear industry.

NOTES

Invited Oral – Abstract #4

Nutraceuticals and functional foods from cool climate fruits

Vasantha Rupasinghe*[1]

[1]Faculty of Agriculture, Dalhousie University, Rm 219-C Cox Institute Building, 50 Pictou Rd. PO Box 550, Truro, NS, B2N 5E3.

vrupasinghe@dal.ca

Habitual consumption of fruits and vegetables are known to inhibit various secondary sources of reactive oxygen species and reduce the risk for chronic and metabolic diseases including obesity, type 2 diabetes, cardiovascular disease, neurodegenerative disorders and some cancers. In the field of nutraceuticals and functional foods, one of the current interests is to identify and incorporate antioxidants and health-promoting biologically active compounds of fruits in our diet. In this presentation, scientific evidence will be presented on numerous health promoting properties of flavonoids present in cool climate fruit crops such as apples and haskap berries. For example, we have demonstrated that apple flavonoids can act as strong dietary antioxidants and exert a broad range of functions to prevent harmful effects due to oxidative damage. A flavonoid-rich extract of apple has been shown to reduce the risk fa ctors of atherosclerosis, exert strong neuroprotective and possess cancer chemopreventive properties. Examples of nutraceutical and functional food products developed and assessed from cool climate fruit crops will also be presented.

NOTES

Invited Oral – Abstract #10

Avocado bioactives in cancer chemotherapy

Paul Spagnuolo*[1]

[1]Department of Food Science, University of Guelph, ON N1G 2W1.

paul.spagnuolo@uoguelph.ca

Acute myeloid leukemia (AML) is a devastating hematological malignancy characterized by poor patient outcome and suboptimal chemotherapeutics. Our lab discovered avocatin B, a lipid derived from avocados, with potent and selective toxicity toward leukemia and leukemia stem cells. Mechanistically, avocatin B targeted mitochondria to inhibit fatty acid oxidation resulting in ROS-mediated apoptosis. A formulation has been created and tested to better understand how avocatin B could impart this toxicity *in vitro* and *in vivo*. This talk will highlight this latest research as well as preliminary findings that has tested this compound in human clinical trial.

NOTES

Oral – Abstract #117

The value of sensory and consumer science in postharvest evaluation of fruits

Amy J. Bowen*[1]

[1]Vineland Research and Innovation Centre, 890 Victoria Avenue North, Box 4000, Vineland Station, ON L0R 2E0.

amy.bowen@vinelandresearch.com

A primary goal of postharvest management of fruits is to ensure a high quality products reach the consumers. Unfortunately, improper storage can lead to postharvest deterioration due to rot or chilling injury. For example, peaches are susceptible to chilling injury, with symptoms such as mealy texture and reduced flavour developing if stored under non-optimal conditions. In apples, as well, mealiness is as a major detractor from preference, with consumers preferring apples with juicy and crisp textures. While many analytical methods have been investigated, currently, the use of sensory evaluation techniques such as descriptive profiling using a trained sensory panel are the most accurate in detecting mealiness. Sensory panels are not always accessible to growers and retailers thus their utility as research tool if often overlooked. At the Vineland Research and Innovation Centre, sensory and consumer science are integral to the evaluation of horticulture products. Providing results from recent research studies on peaches, apples, and tomatoes this talk will highlight how sensory and consumer methods are incorporated to evaluate best practices for postharvest storage conditions, track changes in maturity, flavour development, and freshness, and link to consumer preference drivers.

NOTES

Oral – Abstract #111

Oxidative stress signatures in apple and pear fruit: predictive tools for storage-related disorders

Gale Bozzo*[1]

[1]Department of Plant Agriculture, University of Guelph, 50 Stone Rd. E., Guelph, ON N1G 2W1.

gbozzo@uoguelph.ca

Apple and pears are prone to postharvest senescence, which is associated with ethylene-mediated ripening, culminating in low quality fruits that are unacceptable for the commercial market. Freshness of these pome fruits can be preserved by application of the ripening inhibitor, 1-methylcyclopropene (1-MCP), and controlled atmosphere (CA) storage, specifically low temperature, low oxygen and/or elevated carbon dioxide. Unfortunately, these practices can promote the occurrence of storage-related disorders, including flesh browning and cavities in fruit of susceptible cultivars. To date, little is known with respect to the biochemical signatures that promote these storage-related disorders. Our research is investigating the temporal link between oxidative stress metabolism (e.g., ascorbate, glutathione, and gamma-aminobutyrate) and the development of physiological injuries in pome fruit in response to 1-MCP and CA. We have determined that a decline in total glutathione and total ascorbate concentrations was associated with senescent scald and internal breakdown development in stored pears, including fruit of novel fire-blight resistant cultivars, such as 'Cold Snap'. Conversely, the occurrence of internal cavities in pears was dependent upon gamma-aminobutyrate accumulation, as well as altered levels of other oxidative stress and fermentative metabolism signatures. Moreover, we have determined that gamma-aminobutyrate accumulation and loss of total glutathione were correlated with CA-related injury in 'Honeycrisp' apples during prolonged elevated carbon dioxide storage. These biochemical analyses will provide producers and packinghouses with key information to design integral postharvest management strategies aimed at improving apple and pear fruit quality for the fresh market.

NOTES

Oral – Abstract #114

Maintaining the quality of strawberry using post-harvest vapour applications of hexanal

Rob Brandt[1]**, Jayasankar Subramanian[1], Al Sullivan[1]

[1]Department of Plant Agriculture, University of Guelph 50 Stone Rd E, Guelph, ON N1G 2W1.

rbrandt@uoguelph.ca

Strawberries (*Fragaria x ananassa*) are perishable fruit that have minimal post-harvest shelf life due in part to membrane deterioration. Phospholipase D (PLD) is one of the key enzymes responsible for catabolism of membranes during senescence which contributes to the loss of fruit quality. Hexanal has been shown to be an effective inhibitor of PLD which aids in maintaining the post-harvest quality of fruit. Dr. Paliyath from the University of Guelph has utilized hexanal's ability to inhibit membrane deterioration to develop a post-harvest extension application known as the Enhanced Freshness Formulation (EFF). The objective of this study was to determine the effectiveness of hexanal as a post-harvest extension technology. In other experiments a pre-harvest EFF application was tested in field grown strawberry. In this study, a post-harvest hexanal vapour application was tested on greenhouse grown strawberries. Visual marketability and quality parameters such as firmness, soluble solids and colour were repetitively tested over time to assess the viability of the technology in strawberry production. Although minimal post-harvest gains were obtained through the different uses of hexanal, a consistent improvement in visual marketability was observed in the treated fruit compared to control (22% gain after 5 days). Quality parameters were also maintained with no detrimental effects caused by the hexanal applications. Through these and future experiments an enhanced understanding of the potential of hexanal as a post-harvest extension technology could lead to decreased losses in strawberry.

NOTES

Oral – Abstract #123

Genome Size, X-Ray Sensitivity and DNA repair in vegetables and trees as model systems.

John Einset*[1] and Andrew R. Collins[1],

[1]Faculty of Medicine, University of Oslo, Oslo, Norway.

john.williameinset@gmail.com

We wanted to study genome size/radiation sensitivity relations with plants because this subject has received limited attention during the last 50 years since research demonstrated that substantial differences in radiation sensitivities exist, for example, between tree species with large (e.g. pines) versus small (e.g. oaks) genome sizes. Taking advantage of the wide range of plant genome sizes and the availability of diverse plant material in the local grocery, we investigated radiation sensitivity with the alkaline comet assay in isolated nuclei exposed to X-rays. Two possible explanations were considered: 1) inherently higher sensitivity of larger genomes and/or 2) impaired DNA repair. In terms of genome size effects, experiments exposing isolated nuclei from 6 different plant species to X-rays, varying in genome sizes from 2.6 Gbp to 19.2 Gbp, showed that larger genomes are more sensitive to DNA damage by a relationship approximating the cube-root of the nuclear volume; e.g. a 10-fold increase in genome size increases sensitivity by about 2-fold. With regard to DNA repair, two conifer species, Sawara cypress (*Chamaecyparis pisifera*, 8.9 Gbp genome size) and Scots pine (*Pinus sylvestris*, 20 Gbp genome size), both effectively repaired DNA damage within 50 and 70 minutes, respectively, after acute X-ray exposures. Both species also showed delayed repair of double-strand DNA breaks, as we previously showed with *Arabidopsis* and *Lolium*. Potential relevance to assessing damage during postharvest storage will also be discussed.

NOTES

Poster – Abstract #214

Is 1-methylcyclopropene application an effective strategy for improving the shelf-life quality of controlled atmosphere stored pears?

Edward J. Flaherty*[1], Jennifer R. DeEll[2], Barry J. Shelp[1], Gale G. Bozzo[1]

[1]Department of Plant Agriculture, University of Guelph, Guelph, Ontario, Canada N1G 2W1;
[2]Ontario Ministry of Agriculture, Food & Rural Affairs, P.O. Box 587, Simcoe, Ontario, Canada N3Y 4N5.

gbozzo@uoguelph.ca

1-Methylcyclopropene (1-MCP) is an ethylene antagonist designed to control postharvest ripening and senescence in climacteric fruit. Here, we tested the hypothesis that 1-MCP improves the overall quality of 'Cold Snap' pears following controlled atmosphere (CA) storage. In two separate years (2013 and 2015), shelf-life quality of 'Cold Snap' pears was assessed following treatment with 1-MCP (0 or 300 ppb), pre-storage conditioning at 3°C (for 0, 3 or 7 d), and CA (18 or 2.5 % oxygen, and 2% carbon dioxide) storage at 0°C for approximately 4 months. On the whole, 1-MCP limited senescence over a 14-d shelf-life period, as evidenced by reduced peel yellowing and fruit softening. In both years, the occurrence of the physiological disorder senescence scald was lowest in fruit stored at 2.5 % oxygen/2% carbon dioxide, regardless of pre-storage conditioning. In 2013 internal breakdown and internal cavity development were also limited by this treatment combination, whereas in 2015 1-MCP exacerbated the development of internal cavities. Principal component analysis established that development of internal cavities after CA storage was, with the exception of fruit softening, consistently associated with most physiological indicators of ripening in both years. The development of internal breakdown and senescent scald was linked to ripening-related phenomena, such as peel yellowing and fruit softening. This study provides pear-fruit packing houses with key diagnostic information on the impact of 1-MCP and pre-storage conditioning on the overall quality of CA-stored 'Cold Snap' pears.

NOTES:

Conference room wireless network: CSHS_Conference ***Password: cshs6023***

NOTES:

Canadian Society for Horticultural Science

National Conference October 4 - 6, 2018

https://agbio.usask.ca/cshs2018/

http://cshs.ca/

Marriott on the Falls Hotel
Niagara Falls, Canada

Thanks to our following sponsors!

heliospectra™

HAWTHORNE GARDENING CO

Canadian Science Publishing

GOLD

7 ACRES

vineland RESEARCH & INNOVATION CENTRE

SILVER

Millenniumsoils Coir® Naturally the best organic substrate

AgMedica BIOSCIENCES INC

University of Guelph

Niagara Fruit & Vegetable Growers' Association

NIAGARA PARKS

BRONZE

BioChambers PROVIDING GROWTH TO RESEARCH.

GREENHOUSE CANADA

THE GROWER

Agricultural Institute of Canada aic

FRIENDS OF THE CSHS:

ThermoFisher SCIENTIFIC

GIFS | GLOBAL INSTITUTE FOR FOOD SECURITY

Growing science for life

Nutrien - a Founding Partner

Ontario Ministry of Agriculture, Food and Rural Affairs

PLANTPRODUCTS®

*Presenter **CSHS student to be evaluated for a Presentation Award