BC Agricultural Climate Adaptation Research Network

B.C. AGRICULTURAL CLIMATE ADAPTATION RESEARCH
Provincial Workshop 2019

Four Points Conference Centre * Kelowna, B.C.

Applied Research Sessions Program Guide December 2, 2019

Wine Grape Stream
Meritage Room A, 1-4 pm

1:00 - 1:20 pm

Building resilient vineyards through cultivar diversity
Dr. Elizabeth Wolkovich, University of British Columbia

Predicted impacts of climate change on crops include major yield declines and the loss of conservation lands as agriculture geographically shifts with changing temperature and rainfall patterns. Such projections, however, rarely include options for growers to change their practices in step with climate change. Negative impacts of climate change on crops could be mitigated by adaptation strategies, including exploiting existing diversity within crops. Here I review this possibility for winegrapes, with a focus globally and locally in the Okanagan winegrowing region. Globally, winegrapes possess tremendous diversity across their 1,100 planted cultivars (varieties) in traits that affect responses to climate, such as phenology (timing of recurring seasonal events such as budburst, flowering and veraison) and drought tolerance. Shifting cultivars can help maintain most current growing regions in place given moderate levels of warming, but benefits decline at higher warming levels. Thus, cultivar diversity can greatly reduce agricultural losses globally, but its effectiveness will depend on global decisions regarding future emissions and how well the approach can be adapted to spatial and temporal scales relevant to growers. Working with growers in the Okanagan, I am developing new models at relevant local scales to predict phenology, from budburst to sugar maturity, for winegrapes. Such models can help build resilient local agricultural systems by guiding management each season and, in the longer-term, by guiding planting decisions through future projections. Beyond winegrowers in the Okanagan, this general approach may apply to diverse crops across BC (e.g., apples, cherries, blueberries).

Speaker bio
Elizabeth Wolkovich is an Associate Professor at the University of British Columbia, where she holds the Canada Research Chair in Temporal Ecology. Her research focuses on how phenology shapes plants and plant communities in forest and crop systems. She is particularly interested in how climate change will affect different winegrape varieties, and how shifting varieties may help growers adapt to warming. Winegrape projects in her lab draw on collaborations and data from France, Switzerland, New Zealand, California and British Columbia.

BC Agricultural Climate Adaptation Research Network

1:30 - 1:50 pm

The effect of deficit irrigation on fruit quality in wine grape production

Dr. Simone D. Castellarin, University of British Columbia

Water availability is arguably one of the major factors limiting canopy growth and grape production in vineyards. Climate change is forecasted to make precipitation more erratic and increase temperatures in many wine regions, making drought events more frequent in vineyards. In dry wine regions, growers often apply sub-optimal irrigation levels, known as deficit irrigation strategies to limit the canopy growth and improve grape and wine quality. In red grape varieties, deficit irrigation improves the accumulation of phenolics in the grapes and the quality of wines. Recent studies have indicated that deficit irrigation strategies could also affect the quality of white grapes and wines. Indeed, water deficit induces the accumulation of grape terpenes that characterize the aroma of white wines such as Viognier, Riesling, Gewürztraminer, and Muscats. Our study in the Okanagan Valley has shown that deficit irrigation strategies can be used as a strategy to save irrigation water and improve wine aroma in white grape varieties.

Speaker bio

Dr. Castellarin is an Associate Professor at the University of British Columbia, and a Tier II Canada Research Chair in Viticulture and Plant Genomics. Dr. Castellarin research focuses on grape production, and how the climate affects grape ripening and quality. In 2009, he received the Rudolf Hermanns Prize (Geisenhem, Germany) for outstanding scientific achievements in horticulture and viticulture. He investigates the ripening processes in grapes and the biological mechanisms that determine grape and wine quality. Moreover, he studies how grape quality is affected by environmental factors (temperature and water). Dr. Castellarin is developing viticultural strategies (irrigation, crop management, hormone applications, leaf removal) to improve ripening and the production of phenolics and aromatics in grapes.

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2 - 2:35 pm

Testing agro-thermal heat treatment of Okanagan grapevines to improve yield & adapt to wet and cold conditions

Chad Douglas, Quails' Gate Estate Winery

This presentation will provide information on, and initial experiences from, a project that is trialing and evaluating the effectiveness of an agro-thermal heat treatment machine to reduce the impacts of temperature extremes and increasingly variable temperatures on wine grape production in the Okanagan. Through a partnership with UBC Okanagan, the project is looking at how agro-thermal heat treatment affects three issues that directly impact yield, quality and management costs for the wine industry:

- extreme and variable temperatures during critical grapevine phenological stages that determine fruit set and final yield
- fungal disease pressure, which increases under variable wet and warm conditions

- extreme winter freezing events that increase the severity of bacterial diseases, such as crown gall of grapevines

Speaker Bio

Chad Douglas, Viticulturist at Quails' Gate Estate Winery, holds a Masters of Science degree in Geography from the University of Otago, New Zealand. He has been managing vineyards for the past 15 years in New Zealand, Oregon and now in the Okanagan Valley. Sustainability and innovative vineyard practices have always been central to his management philosophy.

2:50 - 3:10 pm

Managing emerging diseases in an emerging grape-growing region

Dr. José Ramón Úrbez-Torres, Agriculture & Agri-Food Canada

Grape-producing countries benefit tremendously from the major economic boost that grape and wine industries provide independent from their size. A clear example is British Columbia, where with just over 5,000 ha of cultivated grapevines (0.07% of the world total), the grape and wine industry contributes $2.2 billion dollars to Canada's economy through sales, tourism, and job creation. Though grapes have been cultivated in BC since 1860, it was not until mid-1990s when the industry started booming. Currently, BC is home to 275 wineries producing internationally acclaimed award-winning wines thanks to its distinctive geology, topography and microclimates. However, with success also comes challenges. Grapevine hosts the largest number of pests and diseases than any other crop resulting in significant economic losses and increasing production costs. In addition, changes in climate patterns may favor in the short term the introduction and establishment of diseases not present to date in BC vineyards. The aim of this talk is to present ongoing research to better understand emerging diseases of grapevines under BC's particular environmental conditions, and which other issues the BC industry could face in a changing climate. This research is the foundation for the development and implementation of effective management strategies.

Speaker bio

Dr. José Ramón Úrbez-Torres is the plant pathologist at Agriculture and Agri-Food Canada's Summerland Research & Development Centre. He specializes in etiology, biology, epidemiology, and management of fungal, bacterial, and viral diseases of woody perennial crops with an emphasis on fruit trees and grapevines as well as development and implementation of molecular diagnostic tools for plant pathogens.

2:50 - 3:10 pm

Organic amendments and cover crops can enhance yield stability and agricultural resilience in Canadian vineyards

Dr. Mehdi Sharifi, AAFC, Summerland Research and Development Centre

Grape growers are increasingly interested in management practices that enhance long-term productivity while improving the ecosystem health. Optimizing the agroecosystem in a way that the soil remains healthy and fertile leading to grape productivity and quality is challenging, especially with concern coming from climate change and possibilities of increased extreme weather events such as droughts. Organic amendments and cover crops are two management practices that can enhance the health and resilience of the vineyards. Organic amendments contain soluble organic carbon (C) that can be easily transported down the soil profile, and modify soil microbiome, and C cycling. Vertical distribution of soluble C in the soil profile can have an implication in soil and plant health management and consequently affect the resilience of vineyards. In order to encourage a wider adoption of cover crops in vineyards, research must introduce suitable CC species for each region and develop management practices that address trade-offs between provided services and competition for resources need. With climate change and the need to adapt to climate uncertainties (e.g. droughts, heavy rainfall), cover crops can represent a great opportunity to buffer against these uncertainties. Results of two regional projects on surface applied amendments and cover crops will be presented.

Speaker bio

Dr. Mehdi Sharifi is a research scientist at Summerland Research and Development Centre, BC since 2016. Most recently, for 5 years Dr. Sharifi was Canada Research Chair in Sustainable Agriculture and an Assistant Professor at Trent University's School of Environment. From 2010 to 2012, he served as the Nutrient Management Research Chair and Assistant Professor at the Environmental Sciences Department of the Faculty of Agriculture at Dalhousie University (formerly the Nova Scotia Agricultural College). Prior to that he did a two-year postdoctoral fellowship at the Organic Agriculture Centre of Canada in Truro, NS, (2008-2010) and a three-year postdoctoral fellowship at AAFC's Fredericton Research and Development Centre, NB, (2005-2008). Dr. Sharifi's research activities are focused on sustainable nutrient management for perennial horticultural crops including grapes, apples and cherries. His interests extend to the use and management of cover crops, and soil amendments in horticultural crops.

Mini Info Session - Resources for Okanagan Growers

Water Supply Information at Your Fingertips
Kellie Garcia, Okanagan Basin Water Board

Wildfire planning & Invasive Species Resources
Harmony Bjarnason, BC Ag & Food Climate Action Initiative

BC Agricultural Climate Adaptation Research Network

Tree Fruit Stream
Meritage Room B, 1-4 pm

1:00 - 1:20 pm

Changing climate, shifting crops
Dr. Kirsten Hannam, University of British Columbia, Agriculture & Agri-Food Canada

The effects of climate change are being felt across British Columbia. Given that climate is the most important determinant of crop suitability for a given location, climatic change has and will affect which crops can most profitably be grown in BC and where. Crop suitability modelling uses our understanding of growing season requirements, phenological development, and/or critical temperature thresholds for individual crops to determine their suitability across the landscape. Model output using historical and future climate data can help the agricultural sector anticipate the effects of climate change on crop suitability, manage risks and adapt. There are a number of approaches to crop suitability modelling. Agriculture and Agri-Food Canada's Land Suitability Ratings (LSRS) is used to predict the suitability of commercial field crops across the landscape; recent work using LSRS under a range of future climate scenarios suggests that crop suitability for corn may initially improve in the Fraser Valley up to the mid-century but that increasing temperatures will reverse this trend beyond 2050. Similarly, crop suitability modelling for sweet cherry, driven by modules for dormancy, spring phenology and growing season heat requirements, has shown that recent warming has extended the suitable growing region for sweet cherries northward and upslope; climate projections suggest that the Cariboo region may become available for cherry cultivation by the mid-century. In order to support BC's agricultural sector into the future, expansion of transportation corridors and irrigation infrastructure will likely be required, as will a comprehensive assessment of the available irrigation water supply.

Speaker Bio
Kirsten is an agro-ecologist at Agriculture and Agri-Food Canada's Summerland Research and Development Centre. She studies water, carbon and nutrient dynamics within agro-ecosystems at a range of spatial scales.

1:30 - 1:50 pm

Importance of crop drive-rows in soil carbon storage in woody perennial crops; a regional study along the Okanagan Valley
Dr. Andrew Midwood, University of British Columbia

Soils hold large amounts of carbon (C), and have the potential to influence atmospheric CO2 levels. As a consequence of this, considerable research efforts are currently focused on identifying farming practices that increase soil C levels. This is an attractive goal since it can lead to a reduction in atmospheric CO2, and at the same time improve soil quality, through better water holding capacity, nutrient availability and

textural properties. Here we discuss a regional project which involved sampling over 80 apple, cherry and vineyard sites along the Okanagan Valley from Osoyoos to Vernon. We set out to investigate the impact of irrigation on C stored in soils in orchards and vineyards. Overall, concentrations of soil C were highest in cherry orchards, intermediate in apple orchards, and lowest in vineyards. Across all these cropping systems, our work has shown that the soils in the drive rows between the crops have more C in them than the irrigated soils by the crops themselves. Our analysis suggests this C is associated with recently assimilated C and probably comes from shallow rooted grasses and cover crops, together with inputs from pruning debris and litter. By careful management and a better understanding of how C cycles through these systems, the drive rows might be used to deliberately capture atmospheric CO2, helping reduce the impacts of climate change and at the same time, improve soil quality and increase crop yields.

Speaker Bio

Andrew Midwood is a research associate at UBC, and has a background in studying soil C cycling in both managed and natural ecosystems. He is currently working on a 5 year federally fundedAgricultural Greenhouse Gas Project aimed at studying the effects of irrigation on the soils of the Okanagan Valley. He has expertise in the analysis and use of stable isotopes and was originally based in the UK before moving to Canada a few years ago. Andrew has over 20 years of research experience and has collaborated with colleagues from a number of countries including the US, New Zealand, Australia and across Europe.

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2 - 2:35 pm

How ready are we for innovative agricultural practices and to adapt to climate challenges?

Dr. Svan Lembke, Okanagan College, School of Business & Lee Cartier, P. Ag.

This workshop presentation will share for the first time research findings from a survey of 150 BC tree fruit growers about their use of and interest in agricultural technology. The survey took place during the summer 2019 in both English and Punjabi to ensure the findings are representative of the BC Tree Fruit grower community. The study was funded by the BC Tree Fruit Competitiveness Program and executed by the BC Fruit Growers Association together with researchers from the Okanagan College supported by students at UBC Okanagan.

The research findings provide a clear picture of how our BC Tree Fruit Industry requirements for spray records and water management, also the use of smartphones and internet access are shaping our agricultural practices. The ATAR model is used to map technology readiness against the different stages of awareness and adoption. This enables the researchers to benchmark the BC Tree Fruit Industry's ability to adopt solutions and technology innovations for producing high quality fruit under tomorrow's climate conditions. A discussion is sought of how to best expand on our existing readiness for technology and prioritize our training needs.

How can we leap-frog the big data revolution in agriculture for BC Tree Fruits?
Dr. Svan Lembke & Dr. Youry Khmelevsky, Okanagan College

In a region composed of primarily small farms and limited funding for innovation, the BC Tree Fruit industry and supporting organisations have learnt to work together in order to compete with the large producing regions and corporations of the world. With climate change there are many new challenges on the horizon and we again have the opportunity to do things our own way.

This workshop presentation outlines a new project to design simple modular technology improvements that unite growers and pathe the way for our own BC digital revolution. The research is funded by the BC Tree Fruit Competitiveness Program and executed by the BC Fruit Growers Association together with researchers from the Okanagan College.

A step by step process and technology framework will be presented to outline the simplicity of proposed data collection with layers of data privacy and benefits to a multitude of stakeholders. The researchers will use BC tree fruit industry examples to explain data management and integration points across the industry and bring to life the proposed 'System of Systems' approach. Ideas for on-going support and evolution of this technology architecture will be discussed. As this project is only in its early stages, the workshop primarily aims to raise awareness and collect feedback from workshop participants.

Speaker Bios
Svan Lembke holds a PhD from the University of Auckland, NZ, and is a professor at the Okanagan School of Business at the Okanagan College in BC, Canada. Her research focuses on technology innovation and business strategy.

Lee Cartier is a Professor Emeritus at the Okanagan School of Business at the Okanagan College in BC, Canada. His research interests are in the areas of rural entrepreneurship and industry competitiveness.

Youry Khmelevsky is a professor in Computer Science at Okanagan College.

2:50 - 3:10 pm

Managing fire blight and scab with the BC Decision Aid System for Integrated Pest Management
Molly Thurston, Claremont Ranch Organics and Pearl Agricultural Consulting, Inc.

This presentation will include an overview of the BC Decision Aid System and how it is being used by Okanagan and Similkameen Valley tree fruit growers and industry consultants to manage two of the most important diseases that affect pome fruit.

Speaker Bio
Molly is a Horticulturist and organic tree fruit producer in Lake Country, BC. Her educational background includes a BSc. in Agriculture Science from the University of Guelph and a MSc. in Biology from UBC

Okanagan. Molly is a Professional Agrologist and has worked with tree fruit growers in the Okanagan Valley for the past 14 years. She has recently started her own agricultural consulting practice, focused on promoting innovation and providing agronomic support to fruit growers and packers.

3:20 - 4:00 pm

Postharvest deficit irrigation for improved resilience of cherry to climate change

Louise Nelson, University of British Columbia, Okanagan Campus; Bart Fieten, Carcajou Fruit Co. and Gayle Krahn, Jealous Fruits

With climate change, cherry production in British Columbia's southern interior is expanding northward and to higher elevations. Expansion of agricultural capacity requires more efficient water use and consideration of potential for frost damage. We have shown earlier that postharvest deficit irrigation (PDI) (25% reduction in water applied postharvest) can reduce water use without compromising fruit yield or quality, but the effects of further reductions in PDI are unknown. By altering soil moisture patterns, PDI may have unexpected effects on the development and maintenance of cold hardiness. We are assessing the effects of two levels of PDI (25 and 50% reduction) on sweet cherry (Sweetheart cultivar) fruit yield, fruit quality and cold hardiness at five commercial orchards along a latitudinal and an elevational gradient in the Okanagan Valley. PDI was initiated in August 2019 and in the following three years we will monitor soil moisture, plant water status, photosynthesis, vegetative growth, pruning weights, fruit yield, and standard fruit quality measures before and after cold storage. We are monitoring bud cold hardiness and stem dormancy at regular intervals during the fall and winter, and will integrate these measurements into a predictive model for sweet cherry cold hardiness. We will develop a cost-benefit analysis of adoption of PDI using standard economic methods. These studies will allow us train two graduate students and to develop best practice recommendations to assist cherry growers in adapting to changing climate. Our collaborating producers also will present their perspectives on the significance of this research for cherry production.

Speaker bios

Dr. Louise Nelson is an Honorary Professor in the Department of Biology, University of British Columbia, Okanagan Campus. She is a soil microbiologist with more than 30 yearsâ€™ experience working in the agricultural sector in Saskatchewan and British Columbia. Her research has focused on plant-microbe interactions, plant growth promoting rhizobacteria, biological control of plant fungal pathogens and nitrogen cycling in agricultural soils. She recently led a FAIP study to identify sustainable orchard floor management practices and water delivery systems to optimize water use efficiency and soil health in cherry production as it expands northward in the Okanagan with climate change.

Bart Fieten is an orchardist in Summerland, BC. After graduating from Wageningen University with a Masters in Plant Science, he started working for Carcajou Fruit which operates and packs 50 acres of sweet cherries. Over the past few years he has been Project Manager in the establishment of a 70 acre cherry orchard for Savanna Ridge Cherries.

Gayle Krahn is the Horticulture Manager at Coral Beach Farms, one of the largest sweet cherry growers in Canada, which sells its products under the trade name Jealous Fruits.

Keynote Speakers

Meritage Room A & B, 5-6 pm

Developing resilient orchards for a future environment

Dr. Lee Kalcsits, Washington State University

Increased volatility in temperatures are creating less predictable snow packs, hotter summers, and changes to seasonal patterns that will affect orchard productivity and quality. High yields and reduced losses to disorders will be required to maintain profitability and to increase the sustainability of production under these changing environments. Irrigated regions of the Western North America rely on a steady supply of water from melting snowpack in nearby mountain regions. In these areas, decreased summer water flows will require the development of water conservation practices that do not negatively impact productivity or quality. Earlier bud break and later frosts will change dormancy and chilling patterns and change frost risk for most apple production regions in the country. Lastly, higher summer temperatures and earlier fruit maturity will increase the risk of sun-related damage. All of these impacts will require changes to management practices that conserve resources while still maintaining quality and productivity. Here, we highlight several strategies to mitigate the impacts of climate change and conserve water resources. These include the use of protective netting to optimize the light environment to reduce heat related losses while also conserving water through reduced evapotranspiration and reduced evaporative cooling. Other strategies include irrigation management to reduce postharvest losses due to heat and nutrient imbalances in susceptible cultivars. Lastly, we highlight the need for more research to develop cultivars that can better withstand changing environmental pressures. These combined strategies will better guide mitigation and adaptation strategies that will help maintain apple production in the future.

Speaker bio

Dr. Lee Kalcsits is an assistant professor of tree fruit physiology in the Department of Horticulture at the Washington State University Tree Fruit Research and Extension Center in Wenatchee, Washington, USA. He completed a BSA in Horticulture and a MS in tree physiology at the University of Saskatchewan and a PhD in Forestry and Tree Physiology at UBC. He has been at WSU since 2014. His research works towards understanding the interactions between environment, horticultural management and genetics of tree fruit. Specifically, his work is focused on understanding heat and water relations in apple and developing strategies to mitigate those problems.

Increasing Resilience to Climate Change: Approaches from California's Wine Grape Sector

Ann Thrupp, PhD, Down-to-Earth Innovations

This presentation will include a summary of innovative initiatives, programs, and practices being used by winegrape growers and wineries in California to address climate change, and to improve sustainability and resilience to climate-related challenges. It will highlight policy measures, proactive steps to improve energy efficiency and adoption of renewable energy technology to reduce GHG emissions, as well as soil health practices to increase carbon sequestration and water conservation methods. Research projects

and measurement protocols to assess GHG emissions and carbon storage will also be mentioned. Dr. Thrupp will identify lessons learned, stressing the importance of fostering innovation, proactive leadership, and diversity to enhance resilience and sustainability.

Speaker bio

Ann Thrupp is the principal and founder of Down-to-Earth Innovations, providing consulting services in sustainable and equitable agriculture and food systems. She also serves as Director of the California Food Is Medicine Coalition, composed of community-based non-profit organizations that provide meals and support to individuals facing serious illness. Dr. Thrupp has held leadership positions over 25 years, in non-profit organizations, government, academia, business, and as a practitioner and educator. Previously, she was Manager of Sustainability and Organic Development at Fetzer/Bonterra Vineyards for 10 years, and Managing Director and consultant for CA Sustainable Winegrowing Alliance in 2004-08. Ann was Director of Sustainable Agriculture at World Resources Institute for a decade, doing international work in partnership with organizations in Latin America, Africa and Asia. She has a PhD and Masters degree from Sussex University and a BA from Stanford University, and has over 75 publications. She served on a Scientific Advisory Committee of the CA Department of Food and Agriculture and on two committees of the National Academy of Science, and is a graduate of California's Agriculture Leadership Program. Ann is fluent in Spanish and is an accomplished long distance runner.

Research Poster Session

Meritage Room A, 4-5 pm

Agricultural field and landscape scale assessment of changes in soil organic carbon in the Lower Fraser Valley for enhanced climate change adaptation and mitigation

Authors: ***Lyndsey Dowell*** *(presenting), University of British Columbia, Siddhartho Paul, University of British Columbia, Sean Smukler, University of British Columbia*

Increasing soil organic carbon (SOC) is potentially a key component for agricultural climate change adaptation and mitigation. Yet SOC has been projected to be at risk of degradation for much of the agricultural land reserve of the Lower Fraser Valley (LFV), one of the most productive agricultural regions of British Columbia. Intensive annual production and land use land cover (LULC) change can be major drivers of SOC loss. Quantifying the differences in SOC storage related to land use practices and changes in SOC due to LULC change can help improve our understanding of the overall adaption capacity and mitigation potential of the LFV. In a study conducted across the agricultural land of the LFV, we sought to quantify the range of carbon storage potential under different management practices at the field scale and predict changes in stored carbon associated with land use and land cover (LULC) changes at the landscape level. Our approach combined field measurements, remote sensing imagery analysis, and machine learning based modelling to map changes in SOC across our study area from 1984 to 2018.

At the field scale, perennial crops had significantly ($p < 0.05$) lower SOC% on average than wooded field margins. Annual crops had lower SOC% on average than wooded field margins in the top 30 cm, though differences were not significant, nor were differences in SOC% significant when comparing various crop

types. Our landscape-scale prediction of SOC using a Random Forest model and Landsat satellite imagery yielded a goodness-of-fit of 0.70 and normalized root mean square error of 0.09. We identified that 59% of the land area in LFV lost SOC at varying degrees from 1984 to 2018 while SOC gain occurred in only 13% of the land area. These results can help to identify areas in need of SOC restoration and the most effective SOC building strategies.

Presenter Bio

Lyndsey is an MSc student in the Agricultural Landscapes Lab under the supervision of Dr. Sean Smukler. With a background in sustainable commodity sourcing and web tool design, Lyndsey is interested in how to design tools to better facilitate sustainable agriculture. Her graduate research is focused on assessing the role of agricultural beneficial management practices in climate change mitigation and mapping hedgerows and riparian buffers in the Lower Fraser Valley of BC.

Consequences of Elevated Carbon Dioxide on Plant-insect Interactions

Authors: ***Jimmy Kyu Baik Ha*** *(presenting), University of British Columbia, Juli Carrillo, University of British Columbia*

Over the past few decades, CO2 has been rising rapidly. High levels of CO2 can potentially change metabolic processes in plant tissue, as well as their interactions with other organisms. Previous studies have shown that elevated CO2 alters nutrient balance and affects plant defense against different types of herbivores. The Jasmonic Acid pathway (JA) for defense against chewing herbivores like caterpillars, is inhibited at elevated CO2 while the Salicylic Acid (SA) pathway against piercing/sucking herbivores like aphids, is up-regulated in grains and legumes. The objective of my study is to see whether chewing herbivore performance improves at elevated CO2 (e-CO2) and to see if vegetable crop resistance against them is reduced. As a preliminary test, I grew mutant lines of Arabidopsis thaliana plants defective in either the JA or SA pathway, and raised them at ambient (450 ppm) and e-CO2 conditions (750 ppm) at the UBC Forestry plant growth room. I also tested induced plant defense by pre-exposing them to cabbage looper feeding, and comparing them to non-induced plants at both CO2 treatments. Results show that induction significantly reduced cabbage looper growth at ambient CO2, but was much less effective at e-CO2. I will conduct my main trials on tomato plants that are also defective in JA and SA pathways. The main experiment will follow the steps of the preliminary trials, but I will also be looking at the impact of e-CO2 on volatile production and defense-related gene expression as well.

Presenter bio

Jimmy Kyu Baik Ha is a Ph.D student studying at the Faculty of Land and Food Systems at the University of British Columbia, and under the supervision of Dr. Juli Carrillo. I am working on the effects of elevated carbon dioxide on plant-insect interactions at multi-trophic levels. I was born in Seoul, South Korea, but moved to Canada in the early 2000's. In 2008, I was admitted to UBC, where I did my Bachelor's Degree in Biology. I finished my Master's on Insect Growth Regulators at Seoul National University in 2016, and started my Ph.D in 2017.

Influence of Postharvest Deficit Irrigation on Sweet Cherry Cold Hardiness

Authors: ***Elizabeth Houghton*** *(presenting), University of British Columbia Okanagan Campus, Dr. Louise Nelson, University of British Columbia Okanagan Campus, Denise Neilsen, AAFC Summerland Research and Development Centre and Kirsten Hannam, AAFC Summerland Research and Development Centre*

Climate change is expanding the suitable growing conditions for cherries to higher elevations and latitudes in the southern interior of British Columbia. With this expansion comes the concern of an increasing water demand and the potential for crop frost damage at these more extreme growing sites. Postharvest deficit irrigation (PDI) can be used to improve water efficiency but its impacts on cold hardiness are currently not well understood. Working with local commercial cherry growers, a study of the implications of postharvest deficit irrigation on sweet cherry cold hardiness over three growing seasons has begun this year in four orchards across a latitudinal and elevational gradient in the Okanagan Valley. A 25% and 50% reduction in postharvest irrigation has been employed and fruit bud cold hardiness will be measured throughout the fall and spring. This study will assess the role of PDI in enhancing cherry resilience to climate change and contribute to improving water management practices in the Okanagan Valley.

Presenter Bio

Elizabeth Houghton is in her final year of a B.Sc. in Earth and Environmental Science at the University of British Columbia (Okanagan). She is currently working as a full-time co-op student researching the influence of postharvest deficit irrigation on sweet cherry cold hardiness and will be pursuing this project as her thesis topic for a M.Sc. in Biology starting next year.

The Effects of 3,4-Dimethylpyrazole Phosphate Nitrification Inhibitor on Nitrification and Denitrification Microbial Genes Abundances and Nitrous Oxide Emissions

Authors: ***Katherine-Faye Karen Jansen*** *(presenting), University of British Columbia, Okanagan Campus*

Agricultural practices produce substantial amounts of nitrous oxide (N2O), an atmospherically-detrimental anthropogenic greenhouse gas. Soil nitrogen cycling, and consequently, N2O production, is regulated by the soil microbial metabolic pathways nitrification and denitrification. The dominant microbial contributions to N2O emissions vary depending on soil conditions. The inhibitor 3,4-dimethylpyrazole phosphate (DMPP) inhibits the nitrification step converting ammonium (NH4+) to nitrite (NO2-), ultimately reducing downstream production of N2O. Analyzing how DMPP impacts microbial communities may contribute to the knowledge of its inconsistent efficacy. Varying nitrogen-based fertilizer and inhibitor conditions will be tested using Okanagan (Summerland) sandy loam soil, and the effects of DMPP on microbial populations and N2O emissions will be determined. Total bacterial, archaeal, and nitrification/denitrification gene abundances (nirS, nirK, nosZI, nosZII, amoA, and CrenamoA) will be quantified using droplet digital polymerase chain reaction (ddPCR). N2O levels will be monitored using gas chromatography. Nitrification/denitrification genes are expected to increase in soils treated with NH4+ and NO3- type fertilizers. Ammonium and DMPP-treated soils are hypothesized to have decreased gene abundances associated with nitrifiers and denitrifiers (amoA, CrenamoA, nirS, nirK, nosZI, and nosZII). A reduction in nitrifier-associated genes (amoA and CrenamoA) relative to denitrifier-associated genes (nirS, nirK, nosZI, and nosZII) is predicted in trials using NO3- and DMPP. Nitrous oxide emissions are predicted to decrease with DMPP additions, the most substantial decrease occurring in trials with NH4+ type

fertilizers. The results will clarify if DMPP is practical in fields where soil conditions encourage denitrifier populations to dominate.

Presenter Bio

Katherine-Faye Jansen is a Master's graduate student supervised by Dr. Louise Nelson at the University of British Columbia Okanagan Campus. Her interests include microbiology, virology, epidemiology, molecular genetics, and providing environmentally and economically sustainable practices. Her thesis research involves analysis of nitrous oxide (N2O) emissions related to soil microbial nitrogen-cycling gene abundances and 3,4-dimethylpyrazole phosphate N2O reduction efficacy, in varying agricultural soils. Ideally, the outcome of this research will enable her to give practical amendment advice to reduce the production of N2O from agricultural systems. Katherine also enjoys learning about anthropological practices and their influences on the world.

Determining the effect of agro-thermal heat treatment on vine performance and crown gall disease in grapevines

Authors: ***Portiaa McGonigal*** *(presenting), University of British Columbia, Tanja Voegel, University of British Columbia, Okanagan Campus, Chad Douglas, Quails' Gate Estate and Louise Nelson, University of British Columbia, Okanagan Campus*

Crown gall induced by Allorhizobium vitis (A. vitis) is an economically important disease affecting grapevines worldwide; many vineyards of the Okanagan region of British Columbia are presently affected. This soil-borne bacterium systemically infects and persists within grapevines by entering the plant through root wounds caused primarily by freeze/thaw events in the Okanagan. The bacterium can also be introduced into A. vitis-free soil via infected nursery material. Once established, A. vitis infection results in root necrosis and gall formation along aerial plant parts, reducing overall vigour and eventually resulting in vine death. Widespread infection is difficult to eliminate as there is no current standard control method for preventing nor eradicating A. vitis in grapevine. The aim of this study is to determine if agro-thermal heat treatment could be used as an effective and sustainable control method against crown gall in grapevine, as well as to assess the effect of heat treatment on grapevine performance. Short bursts of extreme heat (150Â°C) were applied multiple times into the grapevine canopy of one vineyard in the south Okanagan during the past growing season. A. vitis soil abundance, grapevine performance measures (bloom, veraison, leaf greenness, berry yield, pruning weight), and crop quality (brix, pH, and acidity) were assessed. If successful, agro-thermal heat treatment can be applied to increase fruit set and yield, decrease the use of agro-chemicals, enhance wine quality, and improve profits in a sustainable manner.

Presenter Bio

I am a first year Master's student at the University of British Columbia's Okanagan Campus studying crown gall disease in grapevine. One of my thesis objectives is to investigate possible sustainable management practices for crown gall in the south Okanagan, focusing primarily on vine heat treatment and compost application in vine rows. Another thesis objective is to test potential biocontrol agents against crown gall in grapevine. My research will hopefully result in finding a solution that grape growers can utilize effectively in their vineyards to fight the growing crown gall epidemic in BC.

Examining soil quality in the Fraser River delta following 3-year grassland set-asides

Authors: ***Teresa Porter*** *(presenting), University of British Columbia, Maja Krzic, University of British Columbia, Sean Smukler, University of British Columbia, Drew Bondar, Delta Farmland & Wildlife Trust*

The Fraser River delta region of British Columbia comprises some of the province's prime agricultural. However, soil degradation has become an issue due to poor drainage, heavy winter precipitation, and intensive tillage. The Delta Farmland & Wildlife Trust (DFWT), a regional non-profit organization, provides cost-share options for the establishment of grassland set-asides (GLSA) for up to four years. A GLSA is a field that is removed from agricultural production, seeded with grasses and clover, and left to rest. Because GLSAs are typically implemented for over ten years, the effects of shorter-term GLSAs are not well-understood.

The objective of this study is to evaluate the effects of four-year GLSAs on soil quality. In 2018 and 2019, we collected samples from five sites comprised of a GLSA and an adjacent field continuously managed for crop production. Physical and chemical indicators of soil quality being analyzed include: aggregate stability, bulk density, aeration porosity, pH, exchangeable sodium, total carbon and nitrogen, and active carbon. Data for aggregate stability will be presented. Results will be used to improve field selection criteria for the DFWT GLSA program and support local farmers in preserving soil quality.

Presenter Bio

Teresa Porter is working on her M.Sc. in Soil Science with Dr. Maja Krzic at UBC. She completed her undergraduate degree in Global Resource Systems in 2014. Before returning to do her Masters, she spent four seasons working on small-scale organic farms around BC. Her experience is mostly in mixed vegetable production and she has also worked with herbs, cut-flowers, fruit, eggs, and pigs. Teresa is the current President of the Pacific Regional Society of Soil Science (PRSSS), and is passionate about agroecology and soils!

Climate Change Adaptation Pathways: Supporting Sustainable Local Food in B.C.

Authors: ***Anna Stemberger*** *(presenting), Liese Coulter and C. Shah, B.C. Ministry Of Agriculture*

Building resilience to current climate conditions is a vital first step to becoming more adaptable to climate change. However, over the next three decades, some limits will be exceeded requiring transitions within communities and sectors, including agriculture. To support adaptation decision-making, the Ministry of Agriculture developed the Pathways to Adaptation Framework and User Guide based on climate-related issues for B.C. agriculture. The Adaptation Pathways approach addresses four key challenges in applying climate adaptation to planning and operations: making decisions for multiple possible futures; employing flexible and adaptive planning processes; explicitly identifying and preparing for likely future decisions; and strengthening the adaptive capacity of people and organisations. The process involves creating shared future visions based on an analysis of both current situations and possible futures. This analysis forms the foundation for plausible pathways, including identified triggers and tipping points beyond which some actions may no longer be possible. Monitoring how a pathway is implemented offers lessons to inform the next iterations and identify signposts when approaching decision points.

Presenter bio

Since joining the Ministry of Agriculture in 2015, Anna has worked on several climate policy initiatives, including CleanBC and the Pan-Canadian Framework on Clean Growth and Climate Change. She is currently working on the development of B.C.'s new climate preparedness strategy. Working on the Ministry's climate action team, Anna is involved in the integration of climate change into the Environmental Farm Plan Program and supporting the work of the Climate Action Initiative. Anna has a B.Sc. in Natural Resources Conservation from the University of British Columbia.

Greenhouse gas exchange above potato and pea crops in the Lower Fraser Valley, Delta

Authors: ***Ningyu Quan*** *(presenting)****,*** *University of British Columbia, Andy Black, Rachhpal Jassal, Zoran Nesic, Sean Smukler, Sara Knox, Maja Krzic, Patrick Pow, Paula Resque Porto, Chitra Chopra, Brian Wang, Oscar Zimmerman*

Agriculture contributes ~10% of global greenhouse gas (GHG) emissions, thus posing a significant challenge in mitigating its effects on climate change, while intensive agricultural management continues to be implemented to meet the food demand of an increasing global population. To mitigate its effects, reliable estimates of actual GHG emissions from different cropping systems are urgently required. The goal of this research funded by Agriculture and Agri-Food Canada was to make continuous measurements of nitrous oxide (N2O), carbon dioxide (CO2), and methane (CH4) fluxes above potato and pea crops from June 2018 to October 2019 in the Lower Fraser Valley, Delta, BC. The eddy-covariance (EC) technique used in this research enabled us to make reliable estimates of annual GHG budgets over an integrated area at a farm scale. In addition to EC fluxes, environmental and crop variables including wind speed and direction, radiation components, air temperature, precipitation, soil heat flux, soil temperature and moisture content, leaf area index, crop height and yield were also measured to facilitate the interpretation of the temporal variability of the GHG fluxes. CH4 fluxes were negligible. CO2 uptake during growing season exceeded the loss during the non-growing season, resulting in positive annual CO2 uptake by both crops. The peas fixed more CO2 and emitted less N2O than the potatoes. As a result, the peas had a negative annual global warming potential (GWP) (i.e., GHG uptake by the crop), while the potatoes had a slightly positive annual GWP (i.e., GHG loss to the atmosphere).

Presenter Bio

I'm a MSc student in Soil Science supervised by Dr. Andy Black. I completed my undergraduate degree at China Agricultural University. During my undergraduate, I gained experience in using closed chambers-gas chromatography methodology to measure greenhouse gas emissions under different irrigation treatments in North China Plain. I also worked as a research assistant in Sustainable Land Ecosystems research lab in 2017 summer at the University of Alberta. Currently, my Master's thesis focuses on measuring greenhouse gas exchange from cropping systems in the Lower Fraser Valley by using eddy-covariance technique.