IGRAD

Interdisciplinary Graduate Research & Discovery Conference

Abstract Booklet

University of Toronto, Scarborough Campus

May 6 – 7, 2022

Session 1 | May 6, 11 AM – 12 PM

Transcriptional regulation of FUSCA3 by NAC transcription factors and their role in seed coat development in Arabidopsis thaliana
Patel, Jasmin

Seeds assure the spread and survival of angiosperms and other higher plants. The Arabidopsis seed comprises three major compartments: the embryo, the endosperm, and the seed coat. The FUSCA3 (FUS3) transcription factor plays an important role in seed development by coordinating embryo and endosperm growth. Recently, we showed that two NAC transcription factors, preferentially expressed in the seed coat, bind to the FUS3 genomic region. fus3 and nac mutant seeds showed altered seed coat morphology and mucilage release from the seed coat. Interestingly, in 35S:FUS3 and 35S:NAC co-suppression lines the seed coat is detached from the embryo, and "naked embryos" without a seed coat are found within the siliques. These seeds also show increased permeability and altered germination. We hypothesize that the FUS3-NAC module regulates cell- wall related processes, which are required for seed coat development and seed permeability. Taken together, these results illustrate a role for the NAC-FUS3 module in shaping seed coat development, including mucilage deposition, seed coat permeability and adhesion.

Assessing the effect of drought stress on flag leaf cuticular waxes in Triticum aestivum L.
Kuruparan, Aswini

Wheat (Triticum aestivum L.) is the most widely grown cereal crop in the world. With accelerated climate change, there has been an increase in drought events which has negatively impacted grain yield. One mechanism plants use to defend themselves from environmental stressors such as drought, is by sealing their surfaces with cuticular waxes. Cuticular waxes form a hydrophobic layer which envelope plant aerial tissues and can help reduce water loss. Despite their role in drought tolerance, there is a lack of research on cuticular waxes in Canadian bread wheat cultivars. To address this gap, the flag leaf wax composition of old and new bread wheat cultivars, with years of release ranging from 1842 to 2018, were analyzed in a field experiment. Apart from year-of-release, cultivars also differed in the ecozone they were bred for; Swift Current, Saskatchewan (Western ecozone), Brandon, Manitoba (Eastern ecozone). Additionally, eight bread wheat cultivars were subjected to a drought experiment in a greenhouse and flag leaf waxes were analyzed using gas chromatography and mass spectrometry. No significant differences were observed in the total wax content between treatments, however, drought treated, Western and older cultivars had a significantly higher β-diketone content relative to control treated, Eastern and modern cultivars, respectively. Significant differences in β-diketone content were observed in the field experiment as well. Further investigation into the genes responsible for this response, could help improve drought tolerance in future bread wheat lines.

Accumulation by dispossession: A critical review of the impact and resistance to urban regeneration in sub-Saharan Africa
Ibrahim, Abdul-Salam

Through the lens of Harvey's theory of accumulation by dispossession, this study synthesizes the literature to understand the impact and resistance to urban regeneration in sub-Saharan Africa. The study found the impact of urban regeneration on the urban poor to include diminishing livelihood sources, worsening health and housing conditions as well as the erasure of cultural heritage. In response to these dispossession undertones of urban regeneration, the urban poor adopts both radical and non-radical resistance strategies. The study affirms Harvey's postulation on the facilitative role of the state in accumulation by dispossession through urban regeneration. The tenacious disconnect between labor and capital in the global South is apparent in this study.

Consequently, Marx's postulation of primitive accumulation that suggests the reabsorption of the proletariat into the capitalist production process as surplus labor after being separated from their means of sustenance is not supported by this study's findings. The study recommends an integrated approach to urban regeneration in SSA: one that addresses urban infrastructure and the socio-economic plight of the urban poor.

Session 2 | May 6, 2 – 4 PM

Double-Edged Sword: Experiences of Jewish Physicians in the Warsaw Ghetto, 1939-1945
Villegas, Ana

Jewish physicians occupied a very complex and nuanced position within Jewish intelligentsia that differs from scholarly interpretations which generalizes their experiences and removes the intricacies and complexities of their relationships with the German occupiers, ethnic Poles, and other Jews. Jewish physicians in the Warsaw Ghetto did have certain advantages over other professions that aided in the longevity of their survival due to their medical expertise and knowledge. However, these same benefits often also placed them in dangerous situations and were often short-lived. I argue that Jewish physicians in the Warsaw ghetto experienced the destratification of Polish society differently than most Jewish intelligentsia when the Nazis invaded Poland and established the ghettos. It was this, along with their medical/scientific expertise, and the geographics of their occupation that dictated and influenced their mortality rate. I examined the deteriorating living conditions, inefficient public health measures, and individual experiences of certain Jewish doctors and how they navigated the Warsaw Ghetto's many dangers including but not limited to antisemitism, disease, German officials, starvation, and deportation to killing centres (particularly Treblinka). This research utilized and gathered evidence from translated diaries, legal documents, books, articles, and visual media such as photographs and posters.

HIV-2, integration sites and pathology
Kabi, Manisha

Four decades ago, the HIV/AIDS pandemic started to spread through the world, becoming the most deadly spillover of our time — AIDS killed ten times more people than COVID-19. AIDS emerged from two spillovers from monkeys: one from chimpanzees that became HIV-1, and one from sooty mangabeys that became HIV-2. Patients with HIV-2 have milder AIDS symptoms than patients with HIV-1. For this reason, HIV-2 has attracted less attention from researchers, but the key mechanisms that make HIV-2 less harmful than HIV-1 are not well understood. Both viruses need to integrate their DNA into the host genome. Previous studies in HIV-1 have shown that the genomic sites of proviral integration affect the persistence of infection but almost nothing is known about HIV-2. A cohort study suggests that HIV-2 integrates more often than HIV-1 in heterochromatin where it is silenced. This could be one of the key features explaining the differences between the pathologies. Our research is focused on mapping the integration sites of HIV-2 in cell models and comparing them with available maps of HIV-1 insertion sites. In the long term, this work will help us understand the mechanisms of pathology in the HIV family of viruses.

Drug Delivery methods to mitigate Antibiotic Resistance
Patel, Meera

The emergence of antibiotic resistance has become a public health threat. A major contributor to this global healthcare problem is poor efficiency of drug delivery, exposing the bacteria to low antibiotic concentrations. To help mitigate this threat of antibiotic resistance, we present our work on two nanocarriers, polydopamine nanoparticles (PDNP) and liposomes, that can be employed for a more efficient targeting and stimuli-responsive

drug delivery. For PDNP, we investigated the impact of structure of antibiotics Tetracycline (Tet) and Chloramphenicol (Chl) on: (1) drug loading efficiency on PDNP, either during or after nanoparticle synthesis and (2) efficiency of passive and laser-induced drug release. Our results show that both the molecular structure of the drug and the manner of loading and release are important determinants in optimizing the efficiency of PDNP as a drug nano-delivery system. For liposomes, we focused on a PDNP-liposome-hydrogel hybrid system for a sequential release of two different drugs, Ethylenediaminetetraacetic acid (EDTA) and Rifampicin. Depending on the length and saturation of the lipids used, they have different melting temperatures (Tm), a property that can be employed for sequential drug release of EDTA followed by Rifampicin. Here, the EDTA would enhance the bacterial outer membrane permeability, increasing its susceptibility for rifampicin. Additionally, the photothermal conversion efficiency of PDNP will be used to elevate the temperature and cause this sequential drug release. Overall, the high compatibility of both these nanocarriers, along with PDNP's high photothermal conversion efficiency, make them promising drug delivery methods for mitigating antibiotic resistance.

The role of divergent selection as a driver of genomic evolution in the Neotropics
Luzuriaga, Vanessa

The Neotropics is the most species-rich biome on the planet, but, unfortunately, only few studies have addressed the evolutionary drivers shaping such extraordinary diversity specific to the region. Several geographical and ecological barriers have contributed to the formation of new species in the Neotropics, but the pace at which traits evolve and speciation occurs is often speeded up when ecologically-mediated divergent selection is strong. The series of ecologically-distinct altitudinal zones of the Andes, thus, likely provided ecological opportunity for populations living in different altitudes to rapidly differentiate, accelerating the speciation process. Evolutionary rates of morphological and behavioral traits have been previously estimated to increase as a function of difference in altitudinal range occupancy in passerine birds of the region. However, whether altitude will generate a similar effect on rates of evolution across the genome is still to be determined in the Neotropics. Using genomic scans, we compare the rate at which genomes accumulate adaptive differences in pairs of independent avian sister species occupying similar altitudes versus pairs occupying different altitudes. Here, we use altitudinal differences as a proxy of divergent selection. We predict that species with altitudinal differences diverge genomically and speciate faster than species pairs at similar altitudes.

Positively charged nanoplastics are detrimental to Bacillus subtilis in planktonic and biofilm modes of growth
Perez, Franklin

Nanoplastics (< 1 µm) are small, plastic particles that have been discovered in soil. Due to their small size, chemical and physical diversity, nanoplastics are potentially the most dangerous kind of plastic towards biodiversity. Since the success of biodiversity depends largely on microorganisms, the effects of plastics towards microorganisms has been intensely studied. Yet, majority of studies on plastics and microorganisms focused on aquatic environments with larger, plastic particles, known as microplastics (1 - 5000 µm). To address the impact of nanoplastic in a soil microorganism, I used a suite of analytical tools and microbiological methods to ascertain how nanoplastics of different sizes and functional groups impact the modes of growth of a model soil bacteria, Bacillus subtilis. Positively charged nanoplastics were found to have the most effect on B. subtilis in both its planktonic free-living and surface-associated biofilm forms of life. These effects are detrimental, and include cell death, slower growth, a reduction in biomass and changes in its surface-associated structure which could potentially affect its performance in the natural environment. As Bacillus subtilis is known to symbiotically associate with plant roots, the negative effects of positively charged nanoplastics might inhibit the ecologically significant relationship between B. subtilis and plant health.

Examination of the effects of climate change on crop productivity and non-point source pollution in Ontario
Saha, Ratnajit

The potential impacts of climate change on hydrological extremes have received considerable attention in the Great Lakes region. Global warming is predicted to amplify the hydrological cycle in the form of increased cloudiness, latent heat fluxes, intense precipitation events, and flooding, which in turn may have adverse effects on agricultural practices. The present study aims to identify the impact of extreme weather events on different development stages of crops (soybeans and corn) in Ontario. A total of eleven agro-climatic indices for two planting dates (early and regular) were selected. Daily climatic data (total rainfall, maximum, and minimum temperature) recorded in twelve weather stations from 1937 to 2014 were used to calculate critical thresholds for different phenological crop stages. In the vegetative stage, poor seedling conditions and early flooding frequently occur in central Ontario, especially during regular planting dates. In the reproductive stages, a higher frequency of occurrence of cool nights was also observed in central Ontario (exceedance of more than half of the years examined), especially during regular planting dates. Mid-season flooding more frequently occurs in northern and less so in central Ontario (18% of the time-period examined). The severity of pod-filling and seed development drought are mostly experienced in southern Ontario, especially during regular planting dates. Based on the recent weather trends, our study suggests that the likelihood of nutrient export from non-point sources may be higher in central Ontario, as the opportunities to intensify agriculture increase, with profound implications for the integrity of inland waters.

Session 3 | May 7, 11 AM – 12 PM

What information does the brain capture when looking at crowds?
Sama, Marco

Humans are social animals, relying heavily on identifying others around us. We rely on face-to-face interactions for much of our daily life, such as casual or work-related conversations. Over the decades, research has elucidated the information captured from single-face perception, including textural and shape information from faces, and subsequently how the identity of the person you are staring at is elucidated by the brain. Of course, face-to-face interactions are not necessarily in isolation. There are often others in the background (e.g., talking to someone in a crowded subway or lecture theatre). While recent research has investigated how crowd information is captured by the visual system, there is little information about whether crowds and targeted faces are captured simultaneously, and less on what information is captured from these crowds over time. We sought to investigate how and if such information is represented in the brain. Here participants viewed crowds of faces surrounding a central target and neural data was recorded using EEG. Using multivariate pattern analysis, we were able to decode the neural signals that respond to information pertaining to the surround, the target, as well as facial attribute information such as shape and textural properties. In short, we found that target face identity and identity from surrounding faces are captured simultaneously, and, notably, target faces show similar processing strategies compared as isolated single faces. This may indicate that there are separate cognitive systems when deriving information from crowds versus single faces. We also show that, later in the time course, the visual system does compare surround faces to target faces, and can infer whether a target face is consistent (viz. familial resemblance) with the surrounding faces. This interaction between target and surround faces has previously not been seen in face perception research.

Exploring the Stigmatization of Borderline Personality Disorder Among the General Public
Amestoy, Maya

Borderline personality disorder (BPD) is a severe mental disorder associated with an instability of interpersonal relationships, identity disturbance, and self-destructive behaviours, among other features. One paramount issue that has been shown to lead to adverse consequences among this population is stigma. This is likely due to the complexity of symptoms that comprise the disorder and the belief that it is "untreatable", leaving people with BPD to be seen as "manipulative" and "difficult." Indeed, BPD is among the most stigmatized of all personality disorders. Despite vast research supporting the existence of stigma in BPD among mental health practitioners, there is a lack of research focused on the stigmatizing beliefs about BPD held by the general public. The proposed study aims to address this gap by examining the relationship between BPD and stigma among the general population through a variety of stigma domains. The first objective is to examine how much objective knowledge the general population has regarding BPD and if higher levels of pre-existing knowledge concerning BPD symptoms predict stigma levels (i.e., anger, dangerousness, fear, avoidance, pity, and responsibility). The second objective is to determine whether attaching a diagnosis to a vignette outlining BPD disordered behaviour attenuates stigma and whether the gender of the hypothetical vignette character influences this relationship. The third objective is to assess whether stigma levels differ for the nine symptoms comprising BPD. Finally, this study will investigate what influence participant characteristics (i.e., age, gender) have on stigma levels. This study will be completed remotely through Prolific, an online crowdsourcing platform. Understanding the public stigma surrounding BPD will improve our understanding of the potential consequences of disclosing a diagnosis in specific social contexts. Moreover, this research is necessary to aid in understanding how public stigma might contribute to the worsening of BPD symptoms.

From Older and Colder to Younger and Hotter: Maturation and Performance of Bighead Carp under Climate Change
Dean, Erik

Bighead Carp (Hypophthalmichthys nobilis) are an invasive species that have established and caused great ecological and economic damage throughout the Mississippi River. They continue to expand their range and today, they threaten to invade the Laurentian Great Lakes of North America. It is uncertain how they will perform under climate change and in new environmental conditions; however, potential analogues can be found in Bighead Carp populations around the world. Variable rates of growth and maturation have been observed in populations of Bighead Carp under various climates. At higher latitudes, Bighead Carp grow more slowly and mature later in life but reach larger adult sizes, while those in warmer regions grow faster but mature earlier at a smaller size. Greater survival and reproductive ability are associated with larger body sizes, but earlier maturation allows for faster reproduction and shorter generation times. This presents a trade-off between growth and maturity across climatic conditions. Exploring how Bighead Carp populations are affected by different maturation schedules could therefore inform how they may fare under climate change. Using published data for Bighead Carp worldwide, we parameterized a matrix population model to simulate populations under various rates of growth, reproduction, and survival corresponding to maturation ages of 3 to 8 years. Decreasing age of maturity was revealed to have non-additive effects on population growth. Maturation at younger ages was found to be advantageous to a point, suggesting potentially faster population growth under climate change, but population performance changed non-linearly across maturation ages overall. While anticipated warming may enable greater population growth in some cases, certain environmental conditions could also result in reduced performance for Bighead Carp.

Session 4 | May 7, 2 – 3 PM

Everyday Drinking in Chinese Society: Alcohol and the Making of Chinese Identity, 1680s-1930s
Guo, Jackson Yue Bin

The production, trade, and consumption of alcoholic beverages have been important sites for resistance to colonialism, identity formation, and social distinction in early modern history. Situated in the context of the Qing dynasty (1644-1911) and early Republican China, my dissertation entitled “Everyday Drinking in Chinese Society: Alcohol and the Making of Chinese Identity, 1680s-1930s” studies how alcohol was deeply involved in central processes influencing the historical trajectory of modern Chinese history. The dissertation conceptualizes drinking establishments as important physical, social, and cultural spaces in which elite and ordinary languages, perceptions, sentiments, and civilities came to shape or constitute each other, and hence reconstruct power relations. I argue that popular drinking practices created complex and dynamic social interactions and formed new ways in which class identities and state-society relations were negotiated and reconfigured. Using previously untapped archival sources, such as first-hand cookbooks, private letters, edicts, memorials, and legal sources, the dissertation sheds new light on the interplay of food, law, state-building, and social behavior in Chinese history, and contributes to a broader history about drinking practices in early modern and modern East Asia. It widely engages with contemporary sociological and anthropological literature about drinking, social classification, and emotional theories, including works by Pierre Bourdieu, Marry Douglas, Nobert Elias, William Reddy, Mary Louise Pratt, and Michaela DeSoucey, etc. The dissertation will thus provide scholars with interdisciplinary insights into the role of eating and drinking in the political, discursive, and sentimental constructions of modern Chinese state and nationhood.

Application of Ni-Pd aerogel for electrooxidation of carbon dioxide
Alokozai, Abida

Over the last decade, a drastic increase in the global atmospheric CO2 level has been measured. The increase in CO2 level is very concerning as CO2 is one of the most impactful contributors to climate change due to CO2 production [1]. Electrochemical reduction of CO2 (CO2RR) has been receiving widespread attention due to the capture and conversion of CO2 into a value-added feedstock, making it a very promising strategy precisely in closing the anthropogenic carbon cycle. Also, CO2RR gives a controlled nature (temperature and potential), flexibility in phases (organic to aqueous media), and scalability of the bench-side reaction [2,3]. The synthesis gas (CO) is one of the most economically profitable products of the CO2RR. Due to carbon monoxide's extensive applications in chemical, metallurgical, and pharmaceutical industries. Previous research of CO2RR has been shown a high conversion efficacy when working with bimetallic alloys (Au-Cu, Ag-Cu, Pd-Fe) [4-6] and our group also studied the application of Ag-Pd and Sn-Pd aerogels for CO2RR [7, 8]. In this study, we study the application of Ni-Pd and Ni-Pd/MWCNT aerogels for CO2RR. The catalysts were characterized with Scanning Electron Microscopy, Transmission Electron Microscopy, Elemental Mapping, X-ray photoelectron spectroscopy, and electrochemical techniques such as cyclic voltammetry, chronoamperometry in the conventional and flow electrochemical cells using 0.1 M NaHCO3 as supporting electrolyte. The different ratios Ni and Pd, and MWCNT was used for our CO2RR. Also, a comparative analysis of bimetals with the monometallic Pd and Ni will perform for this study. The results demonstrate the potential of alloying Ni with Pd promotes the electrochemical conversion of CO2.

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Using DNA Nanotechnology to Manipulate Antigen Organization Governing B Cell Activation

Hou, Yuchen

B cells are integral members of the immune system. Upon activation, they differentiate into antibody-secreting plasma cells, making them the targets of vaccination. There is strong evidence that multivalency and high density of antigen is critical for robust B cell activation wherein antigen bind and cluster surface B cell receptors (BCR). However, the exact requirements of the nanoscale organization of antigen remain poorly characterized. Furthermore, studies have shown that BCRs exist in nanoclusters, raising important questions regarding how different antigen arrays associate with receptor nanoclusters to trigger activation. To address this gap in knowledge, we employ DNA nanofabrication technology to design platforms that can display antigen with programmable spacings and valency. These DNA nanogrids are then adsorbed on planar lipid bilayers to mimic membrane-associated antigen presentation in vivo. We found that nanogrid adsorption and mobility on phosphocholine-based bilayers is facilitated by divalent cations and cholesterol and are affected by ligand-functionalization. Furthermore, using fluorescence microscopy, we confirmed that antigen-functionalized nanogrids can stimulate B cells in the membrane-bound context in a density-dependent manner. Our studies so far present DNA nanogrids as a promising tool to assess how antigen organization impacts B cell activation. We will continue developing designs with defined antigen arrays alone, or together with inhibitory ligands to selectively inhibit antigen-specific B cells.