2020 Research Project Summaries

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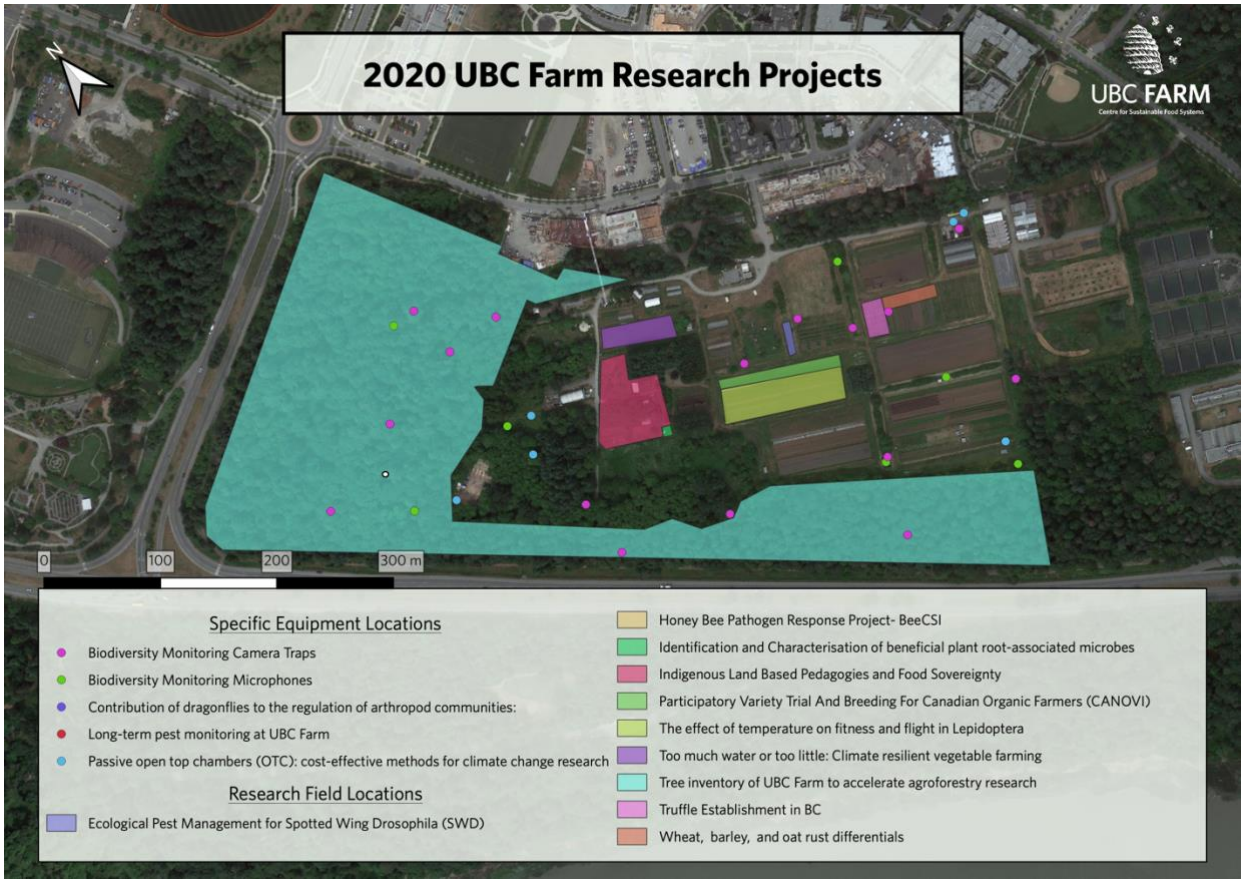
Created on: July 2019
Last updated: August 2021



Honey Bee Pathogen Response Project- BeeCSI

- Led by: Leonard Foster, Faculty of Medicine (Department of Biochemistry and Molecular Biology)
- Established in: 2005
- Research questions:
    - Can we develop tools to quickly identify and differentiate among the multiple stressors (e.g. pathogens, nutrition, pesticides) impacting the health of bee colonies??
    - How do we present these findings in a rapid, manageable way to beekeepers who are seeing sudden bee-population declines?
    - How is bee health changing over time as climate, vegetation, and additional stressors change in the landscape?

- Methods: Dr. Foster and his team are developing a digital tool called BeeCSI- a new platform that will allow beekeepers to quickly diagnose and identify the stressors impacting specific colonies by using genomic analysis . Dr. Foster is using the Farm as a space for his bee hives, providing him with a source of bees for laboratory experiments where they perform genomic analysis to bees exposed to different stressors. The Fam bee hives are also part of a long-term monitoring project where this research group samples, annually, the bees (for genomic analyses), the hive microorganisms, honey and pollen.

Truffle Establishment in BC

- Led by: Truffle Association of BC and Shannon Berch, Adjunct Professor, Faculty of Land and Food Systems
- Established in: 2009
- Research questions:
    - Can Pèrigord black truffle (Tuber melanosporum) be grown in BC using English oak (Quercus robur) as the host tree?
    - What are the best management practices for the successful cultivation of Pèrigord black truffle in BC?
- Methods: Oak trees with root system inoculated with Pèrigord black truffle mycelium were planted as "truffle orchards" in several farms in BC, including UBC Farm, to test if Pèrigord black truffle can be grown in BC and what orchard management practices are ideal to promote the production of Pèrigord black truffle under Pacific NW conditions

Indigenous Land Based Pedagogies and Food Sovereignty in Urban Contexts

- Led by: Eduardo Jovel, Faculty of Land and Food Systems.
- Established in: 2017
- Research questions
    - What are the impacts of the Indigenous Hub on UBC Farm education activities?
    - How can we incorporate traditional indigenous ways of knowing into the UBC curriculum?
    - How are food landscapes experienced in the cities?
- Methods:The study uses a decolonizing research framework and qualitative research methods to ensure the appropriate approach to diverse traditional food systems and Indigenous Ways of Knowing (IWK).

Canadian Organic Vegetable Improvement (CANOVI)

- Led by: Alex Lyon, Research Associate and Hannah Wittman (supervisor), Faculty of Land and Food Systems
- Established at the UBC Farm in: 2019 (as a continuation of a previous project called BC Seed Trials)
- Research questions:
    - What vegetable varieties, from those whose seeds are currently available on the market, are better suited for Canadian organic growers?
    - Can we develop specific vegetable varieties (seeds) ideal for Canadian farmers and seed growers can then they can continue to adapt and improve in a participatory fashion?
- Methods: at UBC Farm 10-20 varieties each of orange carrots, red carrots, rutabaga, and radicchio will be grown, and evaluated, as well as an additional block of carrots for root selection in breeding. These crops have been chosen for the goal of season extension—so they can either be kept in the field and harvested very late in winter (such as

radicchio) or harvested in fall and stored through the winter (carrots and rutabaga). All crops performance will be evaluated in the first four weeks of planting as well as post-harvest. Evaluation will consist of rating the crop varieties for key traits (i.e. how quickly seedlings grow after germination, pest and disease damage, uniformity, resistance to bolting, yield, appearance/marketability, flavor, and storage quality), as well as collection yield data including weight, size, and root number, among others.

Identification and Characterisation of beneficial plant root-associated microbes

- Led by: Cara Haney, Department of Microbiology and Immunology, Michael Smith Laboratories (PI)
- Established in: 2017
- Research questions:
    - What is the genetic basis for plant-microbiome interactions?
    - Once present, how do microbes provide functional benefits to the host?
- Methods: Haney's lab is analyzing the genetic relationship between the wild plant Arabidopsis (a small, weedy mustard plant) and the bacteria Pseudomonas fluorescens. They chose these two because Arabidopsis is already extensively studied and available locally, making it a great model plant; and the bacteria Pseudomonas is already known to protect plants from pathogens and promote plant growth, in addition to being easily traceable with available technical tools.For this research project, Arabadopsis's roots from UBC Farm are first inoculated with the bacteria in the Lab, and then they subsequently perform different genetic analyses to identify any bacterial or plant genes that can benefit the plant's health.

UBC Farm long-term Biodiversity Monitoring Program

- Led by: Matthew Mitchell, Research Associate, Faculty of Land and Food Systems
- Established in: 2019
- Research questions:
    - What biodiversity and species are present at the UBC Farm?
    - How is biodiversity changing over time at the UBC Farm?
    - How do farm management practices and changes to the surrounding landscape affect agricultural biodiversity levels?
    - How can agrobiodiversity be effectively quantified and monitored on working and diversified farms, especially through the use of audio and visual technology?
- Methods: Three levels of biodiversity will be measured- landscape and habitat diversity, crop diversity, and species diversity: Landscape/habitat diversity is being determined by tracking how land use and land cover changes using remote sensing and Geographic Information System approaches. Crop diversity is being assessed by establishing a database, interviewing farm staff, and recording the spatial and temporal distributions of crops and their varieties. Lastly, species diversity is being recorded in different ways depending on the organism (e.g. remote cameras and audio recordings for mammals, and birds, and bats; live capture and release for bumble bees; soil samples for earthworms and soil microbiota; and non-destructive sampling for plants and weeds). In addition, farm management practices and their impacts on biodiversity will be observed by quantifying energy use, fertilizer use, pesticide application, monetary expenditures, and field operations across the Farm.

Monitoring Mammalian Biodiversity at UBC Farm Using Camera Traps

- Led by: Kristen Walker, Faculty of land and Food Systems
- Established in: 2020
- Research questions:
    - What mammals are present on UBC Farm and how do they use the Farm's habitats?
    - What corridors are being primarily used by mammals at the UBC Farm?
- Methods: As part of the Biodiversity Monitoring Plan for UBC Farm, Kristen Walker's project aims to specifically research mammals at UBC Farm. She and her team of four are placing up to 20 new cameras in various forested and production areas of the Farm. The cameras, which are infrared and movement-activated, are placed at ground- or knee-height. This information will be used to determine definite locations of a reduced number of cameras included in the long-term overarching Biodiversity Monitoring Plan.

A Living Laboratory for Water Sustainability

- Led by: Mark Johnson, Institute for Resources, Environment and Sustainability
- Established in: 2018
- Research questions:
    - How can we reduce UBC Farm's water footprint?
    - Can we develop a low-cost measurements network to achieve smart irrigation at the UBC Farm?
    - How is farm water consumption changing along with climate change?
- Methods: By implementing integrated climate and water use monitoring technology at the UBC Farm, this project hopes to monitor long-term water consumption of different farm functions, such as crop irrigation, post-harvest washing and greenhouse water use. Water consumption monitoring will be done through the deployment of a wireless soil moisture monitoring network and associated climate station. Based on the collected information the development of a smart irrigation system will be created based on real-time plant water needs, soil water status and climatic conditions. The project hopes to develop water conservation strategies to help reduce UBC Farm's overall water footprint by at least 20% compared to their current use rates.

Ecological Pest Management for Spotted Wing Drosophila (SWD)

- Led by: Juli Carrillo, Faculty of Land and Food Systems
- Established at the UBC Farm in: 2017
- Research questions:
    - What ecological crop management practices can be used to manage Spotted Wing Drosophila, a fruit fly that acts as a pest in small fruit and berry crops?
        - Using intercropping systems with plants that act as a natural insect repellent (i.e. peppermint) or attract SWD predators (e.g. Sweet alyssum)
        - Supporting natural predators of SWD in surrounding natural areas, hedgerows, and crop margins (after determining the efficacy and necessary conditions)
        - Enhancing crop resistance to SWD through crop-microorganism interactions
- Methods:

  At UBC Farm this research team is investigating the first two of the above questions.

The team will test intercropping methods with Sweet Alyssum, a plant known to attract SWD parasitoids, this summer in strawberry fields. Starting in June, strawberries will be sampled weekly for SWD and their parasitoids. Additionally, native and exotic parasitoids, which are natural enemies of SWD, will be surveyed in the field and surrounding area.

Long-term pest monitoring at UBC Farm

- Led by: Juli Carillo, Faculty of Land and Food Systems
- Established in: 2018
- Research questions:
    - What are the impacts of UBC Farm practices on click beetle and Spotted Wing Drosophila abundance?
- Methods: Click beetles, aka wireworms, as well as spotted wing drosophila, aka fruit flies, are pests of economic importance in BC. This project is monitoring the presence of this pest at UBC Farm. Three types of insect trap are set up in 10 different locations of the Farm near the production plots :
    - 1) Subterranean pitfall traps that have been pheromone baited to attract Agriotes lineatus, a species of click beetle found locally (but is abundant in Europe)
    - 2) Subterranean pitfall traps that have been pheromone baited for Agriotes obscurus, another type of beetle only found locally.
    - 3) Sticky traps to attract all kinds of insects

Too much water or too little: Climate resilient vegetable farming

- Led by: Sean Smukler, Faculty of Land and Food systems
- Established in: 2019
- Research questions:
    - Which soil management practice(s) will result in improved soil water dynamics, crop yields, and farm profits?
    - How do we model the medium-term (10- and 20-year time horizons) impacts of these soil management practices for key soil bio-physical and farm economic outcomes?
    - How can we co-develop a set of site-specific recommendations for improving soil-water dynamics and share them with vegetable producers across the province?
- Methods: Smukler and his team are setting up a range of different soil-moisture management strategies on 32 plots across 12 farm sites in BC. At the UBC farm we will compare three organic amendment treatments and a control in combination with various winter soil cover options. Four amendment treatments will be compared:
    1. High compost application: an application rate of compost that targets crop nitrogen demands, expecting a slow release of nutrients from compost for crops;
    2. Low compost application: an application rate of compost that targets crop nitrogen demands, expecting a fast release of nutrients from compost;
    3. Precision: an application rate of compost that targets crop phosphorus demands and supplements crop nitrogen demand with an organic fertilizer with readily available nitrogen (e.g. feather meal);
    4. Control: No amendments added.

  In the winter, each amendment plot is split in half with either a cover crop or a silage tarp. Soil water content will be monitored by using the soil water-sensors network part of the Living Laboratory for Water Sustainability in collaboration with Mark Johnson. We also are deploying greenhouse gas chambers throughout to monitor carbon dioxide, methane and nitrous oxide emissions to further assess environmental impacts.

Passive open top chambers (OTC): cost-effective methods for climate change research

- Led by: Laura Super (PhD student) and Rob Guy (supervisor), Faculty of Forestry
- Established in: 2020
- Research questions:
    - How do OTCs in forests versus open areas impact microclimate, especially temperature, and how does this compare to nearby areas without OTCs?
    - What are the daily and seasonal patterns of these impacts?

Methods: Six approximately 1.5m in diameter hexagonal OTCs will be installed at UBC Farm, three in the forest and three in open areas. Measurements of air temperature will be recorded approximately every 2-4 weeks within and nearby the OTCs.

Monthly bird surveys conducted by Nature Vancouver

Note: This is not an academic research project. It can be considered a community engagement project and a citizen-science project.

- Led by: Bev Ramey and Sue Kay from Nature Vancouver, a not-for-profit charitable society based in Vancouver, BC.
- Established at the UBC Farm in: March 2007
- Research Questions:
    - What are the long term changes in bird populations as Farm habitats change?
- Project Summary: Nature Vancouver members and volunteers, plus interested public and students have conducted monthly bird surveys at UBC Farm since March 2007, to record the seasonal bird species over the year in nine different habitat areas of the Farm. The surveys encourage public awareness of birds and the biodiversity of the Farm as the monthly surveys are open to the public. All levels of birders are welcome to participate. Long term data on birds and their use of the several habitat areas of the Farm provides researchers insight into how bird use has changed with various changes to the Farm, such as planting of the biodiversity hedgerows, and changes to bird populations over time.
- Methods: Nature Vancouver members and volunteers (plus interested public and students) have conducted monthly bird surveys at UBC Farm since March 2007, to record the presence of seasonal bird species over the year in nine different habitat areas of the Farm. Surveys occur on the third Sunday of the month starting at 8am (March to September) or 9am (October to February). Duration is approximately two to three hours. Bird occurrences are recorded by genus and species, or when identification is not clear, then simply by genus. The bird survey participants walk the same circuit of approximately 3 km each month, and observations of birds (both sightings and sounds) are recorded for each of the nine habitats (stations). In 2014, with permission from Farm staff, seven bird nest boxes were erected and annual bird nesting is monitored . Data from this project provides researchers insight into how site-bird use has changed over time.

Tree inventory of UBC Farm to accelerate agroforestry research

- Led by: Terry Sunderland (Faculty of Forestry), Joli Borah (Post Doc)
- Established at the UBC Farm in: July 2020

- Research questions:
    - What trees are present in the forest regions surrounding UBC, and in what quantities?
    - What types of defects do the local trees possess and do any pose as potential public safety risks?
    - What invasive plants are present in these areas?
- Methods: Each tree in the agroforestry section of the Farm over 10cm diameter at breast height (DBH) will be identified and assessed for defects, notably those that render an individual tree either a potential risk to the visiting public, or as an assessment of compromised productive function. To maintain consistency with the protocol used for the UBC campus tree inventory, other tree attributes measured will include: DBH, total tree height, height to crown base, crown width, percentage canopy missing, and crown light exposure. Each tree will receive a unique number and then will be permanently tagged with aluminium tree tags for ease of identification and accessioning. The ArcGIS Collector app will also be used to visualize the inventory map and data and data collected in the remnant forest of the UBC Farm could potentially also use this on-line system.

Determining effects of urban park management on wild bee reproductive fitness

- Led by: Jens Ulrich (Graduate Student), Risa Sargent (Supervisor)
- Established at the UBC Farm: March 2021
- Estimated Project end date: September 30, 2021
- Research questions:
    - Do wildflower meadows in urban parks significantly improve the long-term health of native, wild bee populations?; and
    - Which plants do urban bees rely on?
- Methods: A thriving, natural nesting location for the studied bees occurs near the UBC farm entrance; these sweat bees construct thousands of nests in the lightly-vegetated, compacted soil in this area. These bees have a high fidelity to their nesting site, typically returning each spring to construct a nest within a meter of the nest where they originated in the previous year. Given this biology and our knowledge of the nesting aggregation at the UBC farm, the research team will place ~30 pots filled with soil at the UBC farm nesting area to be colonized by these bees in April-May. After that, the pots with the nesting bees will be moved off-site and taken to urban 20 parks in Vancouver with different land management approaches. 10 of the parks will include a large wildflower meadow and 10 of them will be traditionally managed (dominated by lawn grass with a few weedy flowers and mowed ~bi-weekly). The studied bees will be free to forage in these contrasting environments from May- July. In late July, the nests will be returned to UBC and placed in tents that temporarily capture the next generation of bees as they emerge. By counting the number of offspring that emerge from each nest and integrating this information with information on overwinter survival and nest establishment success[LM3] [JU4] , the research team will be able to determine the rates at which ground-nesting native bee populations would grow or diminish in the contrasting park management environments. The researchers will also collect pollen samples from the bees throughout the season as they forage in their park environments and will use this information to identify the specific plants that are important resources for these bees.

Wheat, barley, and oat rust differentials

- Led by: Gurcharn Brar, Assistant Professor Faculty of Land and Food Systems
- Project active at UBC Farm: May 2020- December 2020

- Research questions:
- What cereal genotypes are more effective against the effects of the prevalent fungal disease stripe rust?
- Methods: 250 genotypes total of wheat, barley, and oats will be planted at UBC Farm. These are expected to be naturally infected with the disease stripe rust, which is common throughout the Pacific Northwest. Natural inoculation occurs when a disease is acquired from the environment (in this case spores carried by wind will infect suitable host plants), without artificial means. In late summer, samples of infected cereal crops will be sampled and analyzed to determine the effectiveness of certain resistance genes.
- Project expected impact: This project aims to improve knowledge surrounding the effectiveness of different resistance genes in these cereals.

Contribution of dragonflies to the regulation of arthropod communities:

- Led by: Rassim Khelifa (Post-Doctoral fellow), Faculty of Science and Claire Kremen (Supervisor), Faculty of Science
- Project active at UBC Farm: May 2020-Sep 2020
- Research questions:
    - What do the diets of local UBC Farm dragonflies consist of?
    - Do dragonflies affect farm levels of pests, pollinators, and/or their predators at UBC Farm
- Methods: Using transects and hand nets on crop field's edges, the researchers will carefully capture dragonflies in nets, which will then be transferred to a small plastic bag, where the dragonflies will defecate and then been released. This waste will be used to identify the prey eaten by the dragonflies. Movement of dragonflies and foraging areas will also be monitored by attaching light transmitters on the dragonflies' thorax; this will allow us to us to track and gather information on local dragonfly behavior and spatial distribution here at UBC Farm.Sticky traps will also be installed in different locations of the Farm (see map below) to characterize abundance and richness of dragonfly prey available at the Farm to help understanding the habitat preferences of dragonflies and their role in insect population regulation.

The effect of temperature on fitness and flight in Lepidoptera

- Led by: Michelle Tseng (Assistant Professor, Faculty of Science- Botany & Zoology) and Erez Bükükyilmaz (Undergraduate)
- Project active at UBC Farm: May 2020-July 2020
- Research questions:
    - How is climate change affecting the body size and flight capability of insects?
    - What is the effect of temperature on body size and flight in Pieris rapae, the Cabbage White Butterfly?
- Methods: The researchers will examine plants in the Brassicaceae family for adult Cabbage White Butterflies and their eggs. If found, the eggs will be gently removed from the plant using a paint brush and placed in a container. Larvae from the collected eggs will be reared at different temperatures in the Tseng lab, where they will be assessed for any changes in body size and flight capability.

Stating the Obvious: How "Ugly" Labels Can Increase the Desirability of Odd-Shaped Produce

Led by: Siddhanth Mookerjee
Project active at UBC Farm: September 2018 (second iteration in summer of 2020)- October 2020
Research questions:

- How do consumer purchasing patterns change when presented with "ugly" labels on misshapen, but otherwise perfectly fine, fruit?

Methods: A stall will be set up at the UBC Farm that displays and sells misshapen fruits and vegetables. These fruits/veggies will look odd-shaped but will be perfectly fine to eat. The stand will feature a label right next to the box of fruits/veggies, which will either feature the produce's name only, or the produce's name with the word "ugly". Every hour the labels will be switched. In addition, they are displaying a basket of regular-looking produce next to the misshapen produce. Customers
can choose to purchase either the regular-looking produce or the misshapen produce.
Project expected impact: This project will help fill a research deficit surrounding marketing of mitigation of food waste.

RESEARCH PROJECTS COMPLETED BEFORE 2020:

Greenhouse Gas Mitigation in Organic Blueberries

- Led by: Andrew Black and Sean Smukler, Faculty of Land and Food systems.
- Project active at UBC Farm: 2017-2018
- Research questions:
    - How much exactly are the GHG emissions associated with the three major cropping systems in the Lower Fraser Valley in BC (i.e. potato, blueberry and forage crops) ?
    - What crop management practices are beneficial to reduce GHG emissions from these crops?
- Methods: The research at UBC Farm focused on assessing the effect of some of these management strategies on GHG emissions from blueberry crops . Black's and Smukler's Labs compared measurements of CO2, N2O, and CH4 analyzer from the blueberry field where they established three replicates and four management treatments: bloodmeal application with and without new sawdust application, and fertigation with and without new sawdust application. What was done at UBC Farm was only a small part of the larger five-year project entitled "Quantification and mitigation of greenhouse gas emissions from high value agricultural production systems in British Columbia". For this overarching project, a larger UBC researchers team (Andy Black, Sean Smukler, Rachhpal Jassal and Maja Krzic) will also measure the greenhouse gas emissions from potato, blueberry, and forage crops on farms in BC's Lower Fraser Valley to accurately quantify each crop's GHG emissions and evaluate different crop management practices.

Organic Vegetables Nutrient Management Project

- Led by: Sean Smukler, Faculty of Land and Food Systems,
- Project active at UBC Farm: 2014-2019
- Research questions:
    - How well do organic fertilizers perform in terms of crop quality and yield, but also in environmental sustainability (e. g., soil nutrients composition, GHG emissions)?

    - Which are the most efficient (in environmental and productivity terms) organic fertilizers for organic farmers?
    - What are the most efficient application methods (amounts and timing) to improve the economic and environmental performance of organic fertilizers?
- Methods: The use of organic soil amendments (i.e. composts and organic fertilizers) in farms under organic production is much more complex than the use of chemicals fertilizers used in farms under conventional production. Additionally, soil amendments, organic and conventional, are an important source of GHG emissions from agricultural lands.This project is trying to identify efficient and sustainable soil amendment methods for organic production that maximize crop productivity while minimizing GHG emissions from the soil. Researchers are monitoring greenhouse gases emissions, nutrient soil retention and crop performance in 5 different soil management treatments at the UBC Farm Farm and other farms in the province.

Stewardship science technology monitoring the socio-ecological outputs of farming activities

- Led by: Zia Mehrabi
- Project active at UBC Farm: 2016-2018
- Research questions:
    - How can we use emerging digital technology, such as cloud-based and open-source software, to help farmers understand their cost of production and enhance the sustainability of their farms?
- Methods: Zia and his team have developed a mobile phone application called LiteFarm, which aims to track aggregated farmer's crop management data, in a type of public dataset that will be used for research. Farmers who use this app can track their farm's inputs and outputs to support their crop management decisions and organic certification(for organic farmers). The aim of this project is to create the necessary online platform to generate a citizen (i.e. farmer) global crop management database to analyze socio-agroecological trends and their environmental impacts to help inform decision making in politics and agroecology. The UBC Farm was the primary testing ground for this application starting in 2017, and now it is being tested internationally throughout North and South America. The app is slated for full public release in the spring of 2020.