2021 Research Project Summaries

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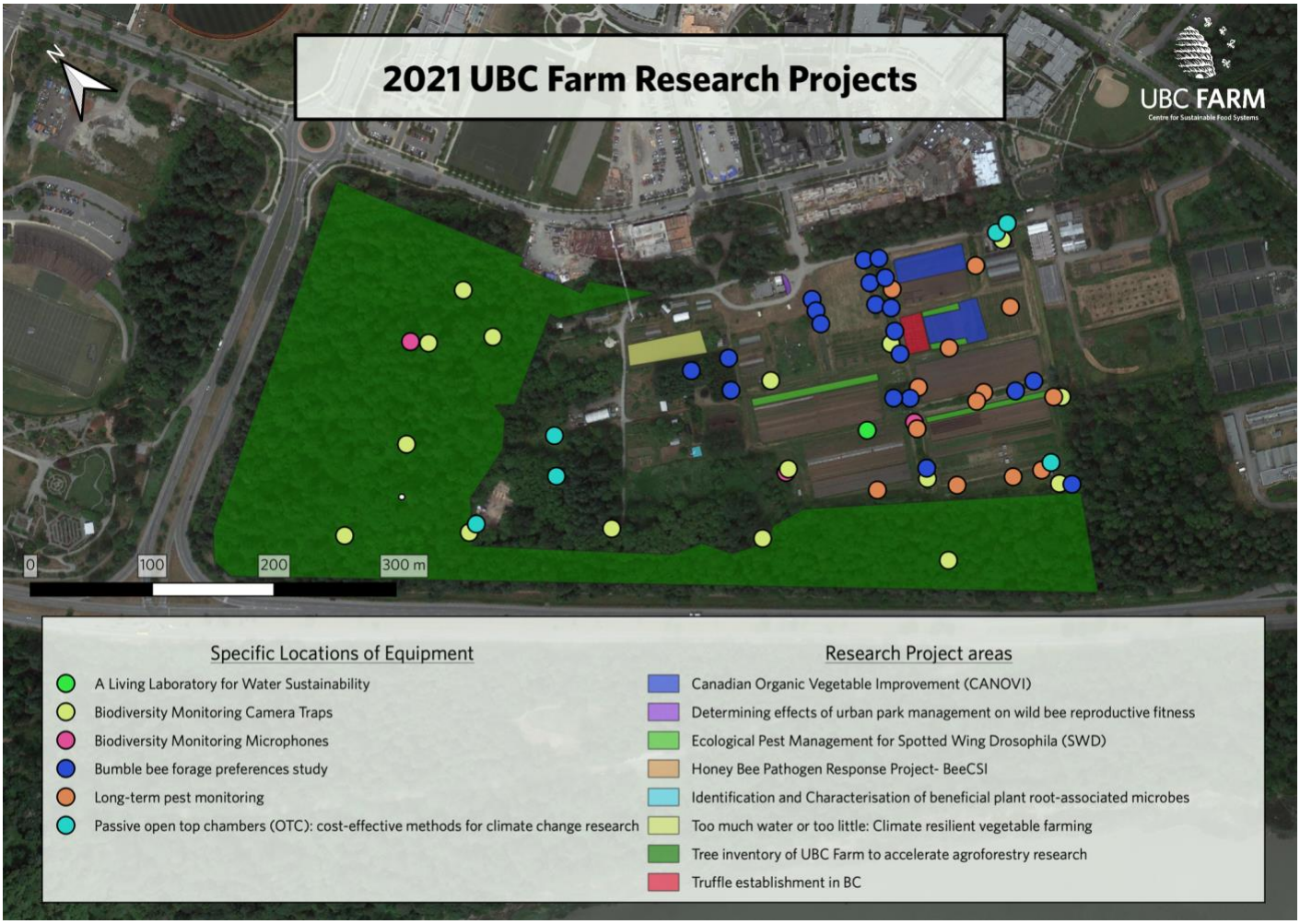
[Click here](#) for the interactive version of the 2021 Research locations Tableau Map:



Map of UBC Farm with active projects listed. Projects occupying fields or regions are denoted by coloured areas on the map, and projects that utilize specific equipment locations (such as the locations of traps or sensors) have been noted as points. (Last updated August 2021).

Contribution of dragonflies to the regulation of arthropod communities

- Led by: Rassim Khelifa (Zoology, Post Doc), Claire Kremen (Zoology, supervisor)
- Established at the UBC Farm: May 2020, renewed July 2021
- Estimated project end date: September 2021
- One-liner project summary: Researchers are studying the diets of dragonflies located at the UBC Farm to determine what impacts their diets may have on pests, pollinators, and/or other natural predators; this helps to provide information on what services or disservices these dragonflies provide in our ecosystems.
- 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 be 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 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 understand the habitat preferences of dragonflies and their role in insect population regulation.

Truffle-Irrigation 2021

- Led by: Becky Loverock (Science Graduate student), Dan Durall (Science Faculty, supervisor)
- Established at the UBC Farm: May 2021
- Estimated project end date: September 2021
- Funding from: UBCO, Truffle Association of BC
- One-liner project summary: Researchers will be testing different irrigation regimes (three different levels of available water in the soil) on the UBC Farm English Oak orchard previously inoculated with black truffle (Tuber melanosporum) over the 2021 growing season to determine how water availability in the soil may impact black truffle production.
- Research questions:
    - What is the best irrigation approach to promote and or increase black truffle production in the Pacific NW using English oak (Quercus robur) as the host tree?
- Methods: Researchers will use the DNA found in the soil of the truffle orchard as an indirect indicator of potential for truffle production. They will take soil samples beneath the inoculated oak trees in the Truffle Orchard prior to the start of the orchard irrigation system to determine black truffle (Tuber melanosporum) levels. Then, the three irrigation regimes (low, medium, and high water availability treatments) will start and soil water availability levels will be monitored using a network of soil sensors. At the end of the season, samples of the soil will be taken one last time to study any changes in the volume of black truffle DNA found.
- Location: Field D5-5, Perennial Oak Truffle Orchard

Clonal plant resource allocation study

- Led by: Chelsea Gowton (LFS Graduate student), Juli Carrillo (LFS Faculty, supervisor)
- Established at the UBC Farm: May 2021
- Estimated Project end date: December 2022

- One-liner project summary: Researchers are sampling various plants in the Rubus genus to determine if variations of resource allocation exist, and how that may affect their ability to establish.
- Research questions:
    - How do clonal plants allocate resources to asexual propagules?; And
    - Are there variations among invasive, agricultural, and native genotypes?
- Methods: Researchers will be conducting a full survey of UBC Farm to identify all Himalayan Blackberry (HB) stands, an invasive berry species in B.C. Small samples will be taken to determine biomass allocation, and during the flowering period (July/August) more samples will be excavated to determine biomass allocation, seed viability, and fruit quality. Then, additional fruit and rhizomes from thimbleberry and salmonberry will be collected for comparison across genotypes.
- Location: Across UBC Farm (for surveying), HB stands, and hedgerows (thimbleberry, salmonberry, and HB).

Bumble bee forage preferences study

- Led by: Jennifer Lipka (LFS Graduate student), Juli Carrillo (LFS Faculty, supervisor)
- Established at the UBC Farm: April 2021
- Estimated Project end date: October 2021
- One-liner project summary: This study seeks to find out what flowers bumblebees prefer and when, which can help growers cultivate more bee-friendly hedgerows and crops at the right times to secure bumble bee pollination services on their farms.
- Research questions:
    - How do foraging bumble bees interact with various temporally-available flowering crops?
    - What series of flowering crops and non-crops, if any, create an optimal foraging season for bumble bees?
- Methods: Non-invasive floral and pollinator surveys will be conducted on weekly intervals throughout the season to measure the abundance, diversity and time availability of floral and pollinator resources at UBC Farm. Floral resources include blueberries, raspberries, apples, strawberries, hedgerows and other intercrops. In addition, bumble bee nest boxes will be established adjacent to various floral resources. Consistently over the course of the season, bees found nesting at these boxes will be captured and their pollen baskets will be studied to determine which flowering crops are preferably foraged. After photographing, they will be released in a non-destructive manner.

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, 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.

- Location: Bee ground-nesting area will be located near the Farm entrance between the Cooler (B17), Electrical building (B15), and roadway fork

Ecological Pest Management for Spotted Wing Drosophila (SWD)

- Led by: Juli Carrillo (supervisor) and Pierre Girod (post doctoral fellow) from Faculty of Land and Food Systems
- Established at the UBC Farm in: 2018
- 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 of the three questions above. In strawberry and blueberry fields this summer, the team will test intercropping methods with buckwheat, dill, borage, and ryegrass- all are plants known to attract SWD parasitoids such as hoverflies and parasitoid wasps.

  Ripe berries will be sampled weekly for SWD and their parasitoids in two ways. First, half will be incubated for several weeks and emerging SWD and parasitoids will be counted and identified. Second, the other half will be submerged in saltwater baths and SWD will be extracted and counted. Should any of the 4 intercropped plants show lower SWD levels, that could provide an effective method for BC farmers to manage pest levels.
- Location: Strawberry and blueberry fields. Fields D3-0 , D7-1 and D5-6.

Long-term pest monitoring at UBC Farm

- Led by: Juli Carrillo (supervisor), Faculty of Land and Food Systems, and Martina Clausen
- Established in: 2018
- Research questions:
    - What are the impacts of UBC Farm practices on click beetle and Spotted Wing Drosophila (SWD), as well as the newly identified invasive strawberry blossom weevil abundance?

- Methods: Click beetles (wireworms), spotted wing drosophila (aka fruit flies), and weevils are pests of economic importance in BC. This project is monitoring the presence of these pests at UBC Farm. Multiple types of insect traps are set up in 13 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 (very but is abundant in Europe and North America)

  2) Subterranean pitfall traps that have been pheromone baited for Agriotes obscurus, another type of click beetle only found locally.

  3) New to 2021: Experimental video traps setup that will record the time variability of SWD abundance and its known parasitoids. These will be located along wild berry hedgerows as well as in the intercropping plots adjacent to strawberry plots.

  4) New to 2021: Pheromone baited traps adjacent to strawberry plots and two hedgerows which will be sampled to capture weevils, another type of click beetle.
- Location on the Map: Across UBC Farm

UBC Farm long-term Biodiversity Monitoring Program

- Led by: Matthew Mitchell (Biodiversity monitoring lead) Faculty of Land and Food Systems, and Kristen Walker (terrestrial mammal monitoring), Faculty of Land and Food Systems
- Established in: 2019
- Research questions:
  - What biodiversity and species are present at the UBC Farm? What terrestrial mammals are present at UBC Farm and where and when are they most active?
  - How is biodiversity changing over time at the UBC Farm as an example of an agroecosystem embedded within an urban-rural landscape?
  - 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. infrared movement-activated cameras (20 on site) and audio recordings for mammals, and birds, and bats (3 recorders on site); 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.
- Location: Various monitoring stations throughout the production and forested areas of the farm.

Canadian Organic Vegetable Improvement (CANOVI)

Led by: Solveig Hanson, postdoctoral fellow 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:

- Of the vegetable varieties currently available from seed companies, which are best suited for Canadian organic growers?
- Can we develop vegetable varieties particularly well-suited for Canadian farmers and seed growers by engaging those stakeholders in the plant breeding process?

Methods: At the UBC Farm, 10 varieties of rutabaga and more than 30 varieties of radicchio will be grown and evaluated. In addition, both orange and red carrots will be grown for evaluation and root selection as part of multi-year breeding projects. These crops have been chosen because they allow season extension: they can either be harvested very late in winter (radicchio) or harvested in fall and stored through the winter (carrots and rutabaga). Varieties and breeding populations will be evaluated for seed germination and vigor in the first 4-6 weeks after planting. At harvest, varieties will be evaluated for pest and disease damage, uniformity, resistance to bolting (going to seed), yield, appearance, marketability, flavor, and hardiness to cold temperatures).
Location: Field D5-6&7 for radicchio and carrots) and field D5-2 (for rutabaga)

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 beehives, providing him with a source of bees for laboratory experiments where they perform genomic analysis to bees exposed to different stressors. The Fam beehives 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.
- Location: Honeybee Hives

Map of UBC Farm showing the locations of projects occupying fields or large spaces. The space occupied by this project is noted in yellow and has a title, whereas all other project areas are shown as green. (March 2021)

Truffle Establishment in BC

- Led by: Truffle Association of BC
- 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.

- Location on the Map: Oak Orchard

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.

Map of UBC Farm showing the locations of projects occupying fields or large spaces. The space occupied by this project is noted in yellow and has a title, whereas all other project areas are shown as green. (March, 2021)

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.

- Location on the Map: C1-1

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.
- Location on the Map: Throughout farm

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.

- Location: The nine stations of the farm include the market garden fields, the herb and flower gardens, the biodiversity hedgerows, and the forested portion of the farm. A 3km circuit of the Farm is also walked to record observations.

Tree inventory of UBC Farm to accelerate agroforestry research

- Led by: Terry Sunderland (Faculty of Forestry), Joli Borah (Post Doc), Diling Liang (MSc student)
- Established at the UBC Farm in: July 2020
- Expected end date at the UBC Farm in: May 31, 2021
- 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 collected in the remnant forest of the UBC Farm could potentially also use this on-line system.
- Location: UBC Farm Forest F1

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.
- Location on the Map: There are several measurement nodes along the Farm and the Washing stations on the Harvest Hut. Micrometeorological station located before fields D4 and D3.