Fund for Innovative Teaching (FIT) Grant – 2020/2021 (with extension due to COVID)
Precision Agriculture Lab: Phase 1 Horticulture - Final Report

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Background

The development of automation and robotics for agriculture is helping to improve the efficiency of food production despite the increasingly smaller pool of skilled agriculture labour. Locally, an example of this is in the dairy sector and the use robotic milking technology. The transition to robotic milking has changed the nature of work on dairy farms. Producers and dairy employees on robotic milking farms can focus more efficiently on animal well-being, including feeding, housing, hoof-health all of which require technical knowledge/training (Rodenburg 2017). A challenge however is that there is often a disconnect between those that develop technology and the end user needs. For example, for horticulture technology promises that farmers no longer need to walk in their fields to detect problems, but farmers still need/want to walk in their fields. At UFV we have an opportunity to bridge this gap because we have programs in production Agriculture, Automation/Robotics and Engineering Physics. Thus, there is the potential for both groups of students and instructors – technology developers and technology end-users – to work together in more collaborative and *realistic* ways. Our project proposed to dedicate one of the bays of the greenhouse into a Precision Agriculture Lab where this type of collaborative teaching and learning could happen.

Progress to date

Although several elements of this collaboration were delayed significantly because of COVID (Spring 2020), the transition to online teaching (2020-2021 academic year) and subsequent supply chain issues (Fall 2021) we were able to make progress on most of the components of our original goals.

1) Development of the Precision Agriculture Lab: As per our original proposal we were interested in exploring the development of precision agriculture technologies specifically for vertical production (Fig. 1). Thus, we purchased vertical growing towers and converted the space for vertical production. To date, we have one type of tower design – but in the future we have the potential to explore other types of tower designs. Additionally, we purchased a contract with Hortau systems for a soil moisture monitoring software and hardware. This allows us to demonstrate to students one form of commercially available sensor technology currently in use by producers (Fig. 2). Pending is the incorporation of sensors developed by students from the Engineering/Physics program.

Figure 1. Bay 3 of the greenhouse converted to vertical production with black and white towers. This type of tower was readily available and allowed us to purchase many units with our FIT dollars, thus giving us flexibility in terms of future course work – for example, we can compare production of one type of crop in towers of two different colours, or multiple crops etc. Tower lay-out can also be modified or made more-dense in the future. These towers could also be compared with other vertical growing systems in the future.

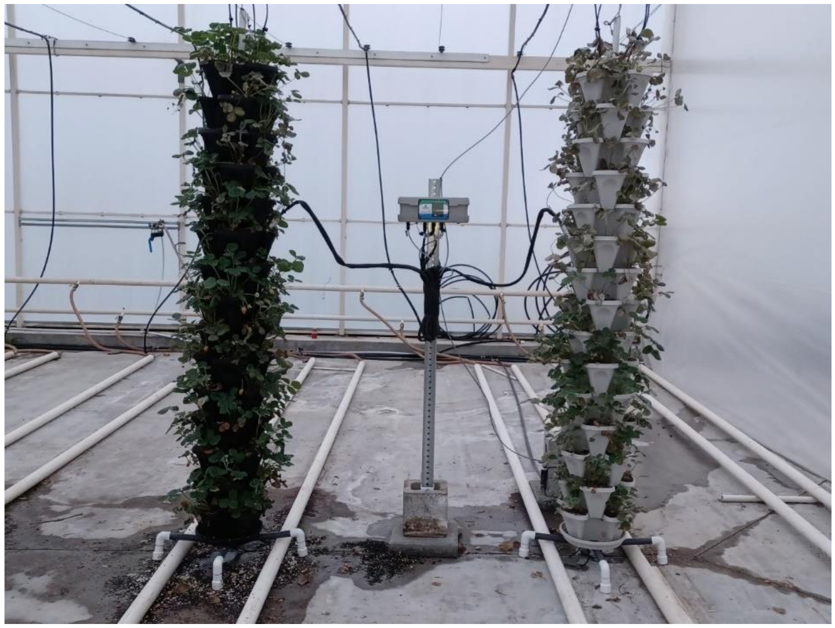

Figure 2. Hortau sensors in a black and white strawberry tower. Each sensor records soil moisture levels in the two towers separately and students were able to compare results (there were no differences). While this type of technology is commercially available and widely used in the Fraser Valley – having enough units to detect soil moisture differences at different heights in multiple towers would be cost prohibitive. Thus, another project for the Engineering Physics or Automation/Robotics students in Winter 2022 or future semesters.

2) Collaborative teaching/learning: In Fall 2021 Agriculture certificate, diploma, and degree students in Agri 323 worked on collecting yield and pest (arthropods and diseases) data from the towers which were planted with strawberries (Fig. 3). One of the major findings of this work by Agri 323 students was that there are dramatic differences in pest infestation levels across towers (Fig. 4). These data demonstrate that each individual tower needs to be treated as a unique production unit, however in a commercial facility this would be prohibitively laborious. Agriculture students identified tower specific monitoring as an example of the type of sensor technology that could improve production efficiency. Results of the Agri 323 work on towers was then shared with Engr 330 on December 1, 2021. These students will be working on developing sensor technology for the towers in Winter 2022 and working collaboratively with Agri 306 (taken by Agriculture diploma (horticulture and livestock) and degree students). (See Presentation prepared for Engr 330 by Renee Prasad, submitted with this Final Report).

Figure 3. Planting strawberry towers on the first day of Agri 323 in Fall 2021 semester (See also: https://www.flickr.com/photos/ufv/albums/72157719857287279/with/51483897666/)

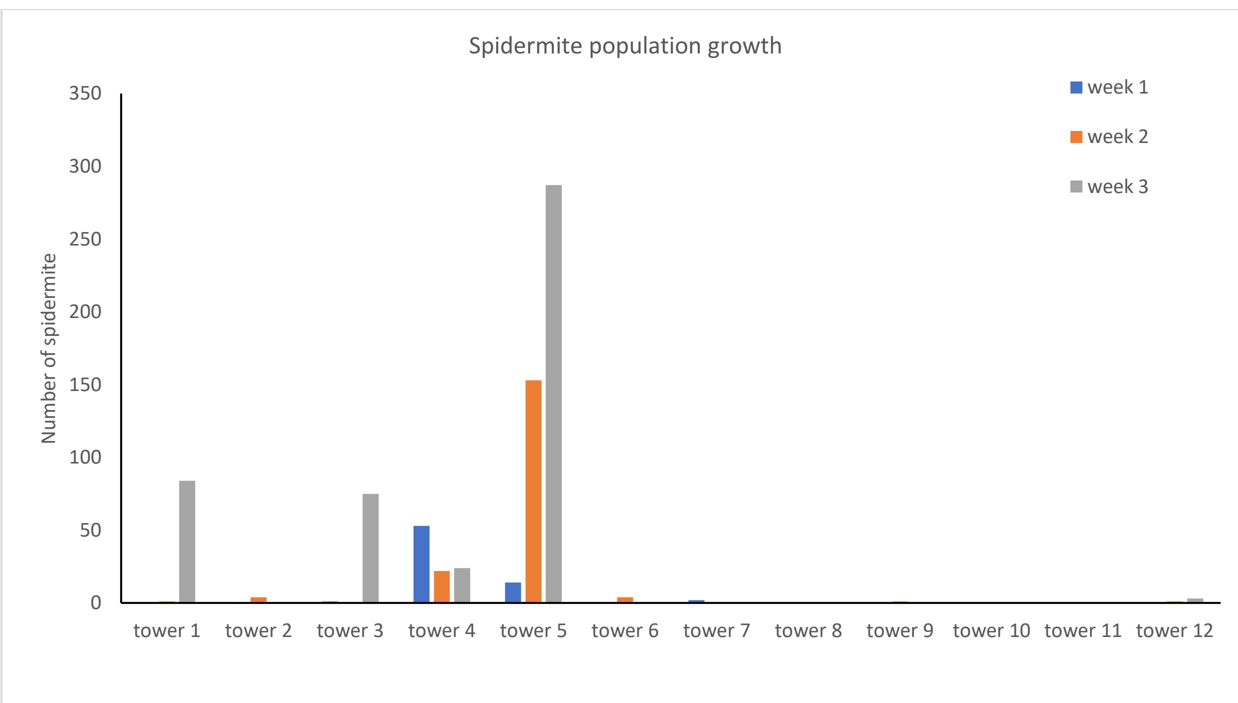

Figure 4. Comparison of spidermite (*Tetranychus urticae*) populations in 12 vertical strawberry towers over a 3-week period (Nov 1 to 15, 2021). Data are based on 15-leaves collected from each tower (5 leaves per upper, middle, and lower tower levels). Data represent adult and immature mites.

Achieving UFV strategic plans and goals

While our project is still on-going, we believe that the work we were able to achieve to date has allowed us to achieve many of the UFV strategic plans and goals, as they were in February 2020. For example, the redesign of greenhouse Bay 3 to a space for the vertical towers and the plan to allow the Engineering Physics students to access that space in Winter 2022 aligns with Vision 2025 "learning drives the system and structure of the institution". These students will need to spend time in the greenhouse, the Agriculture Technology dept. will need to accommodate non-Agriculture students using facilities, instructors will need to be flexible in where classes will be held. This is a lot of unconventional use of unconventional spaces and will require flexibility and creativity to support learning, i.e., "learning drives the system" not the reverse.

We feel our project has already – despite the modified timeline – provided students with an opportunity to "initiate inquiries and develop solutions to problems" and "engage in collaborative leadership". For example, the students in Agri 323 conducted literature reviews and developed their data collection protocols to look at strawberry production in black versus white towers or pest management as part of their course work. Two presentations on the findings of the yield and pest management projects for the towers were then presented to fellow Agri 323 students and three outside agricultural practioneers – Dr. Wim van Herk (researcher with AAFC), Grant Keefer (producer - Yellowpoint Cranberries and the BC Cranberry Research Farm) and Allyson Mittelstaedt (consultant - E.S. Cropconsult Ltd. and UFV Agriculture Certificate alumna). Finally, presenting the results to Engr 330 provided those students with the opportunity to begin asking questions and thinking of solutions to the challenges identified by their Agri 323 peers. We are looking forward to the collaboration that will continue into the Winter 2022 term between Lin Long, Avner Bachar, Renee Prasad and because we will at last have a large enough data set Longlong Huang.

Literature Cited

Rodenburg, J. 2017. Robotic milking: Technology, farm design and effects on workflow. *Journal of Dairy Science* 100(9):7729-7738. https://doi.org/10.3168/jds.2016-11715