Great Lakes Plant Breeding Initiative Trip 2017: Visiting Cornell University

The Great Lakes Plant Breeding Initiative(GLPBI) trip is 3-day event that aims to connect plant breeding students from Universities around the Great Lakes. This includes University of Guelph, Cornell University, Ohio State University, University of Wisconsin-Madison and Michigan State University. The philosophy behind GLPBI is to create a sense of community between the aspiring plant breeders and to provide an opportunity for the universities to showcase their plant breeding programs. This year, the University of Guelph had more than 20 participants signed up to attend the event from July 12th to July 14th at Cornell University. The group included faculty members (Drs. Rajcan, Navabi and Eskandari), staff, and graduate students.

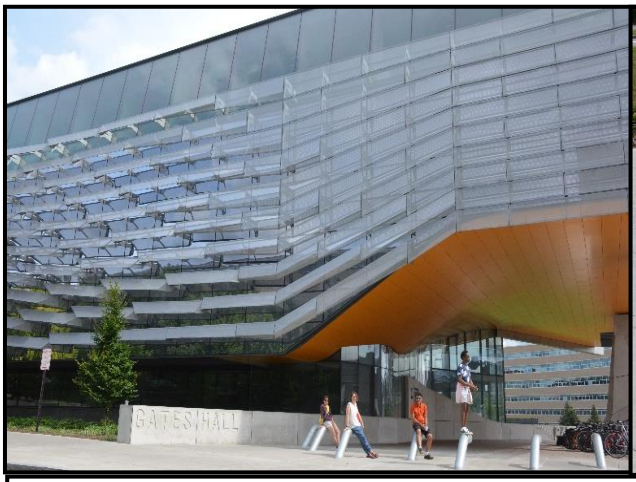
Dr. Rajcan making announcement about important details of the trip and reminding students to drive responsibly.

It takes about 4.5 hour to drive from Guelph, Ontario to Ithaca, NY, where Cornell University is located. Students and faculty members eating lunch at Pembroke rest stop.

After a long drive, the students have finally arrived at the Best Western Hotel where they will be staying for the duration of the event.

Students and faculty looking excited on their way to visit the beautiful Cornell campus. (Left to right: Jennifer Wilker, Maryam Vazin, Baraka Gitari, Dr.Alireza Navabi)

The Schoellkopf Field at Cornell University. It is used for the Cornell Big Red football.



Gates Hall and Touchdown the Bear

In this photo, Dr. Mark Sorrells is talking about his small grain breeding project which includes wheat, barley, oats and rye.

After a long drive Guelph students had the opportunity to visit Dr. Mark Sorrells' small grains breeding program. His breeding program is interested in traits such as fusarium head blight resistance, winter-hardiness, and malting quality. Male-sterility is used to perform recurrent selection. Dr. Sorrells has many interesting projects. For example, he is currently screening a panel of winter barley to

identify facultative barley. The facultative barley has great winter-hardiness and can flower without exposure to cold temperatures. This can be useful when there is a severe case of winterkill in which the farmers can replant again in the spring to rescue some yield. Secondly, he is screening for small grain varieties that can perform well in organic agricultural practices. He believes strongly that although organic cereal production is not currently common, it will be popular in the future. One interesting trait in these organic cereals is that they are relatively tall compared to the current varieties grown in a conventional agricultural setting due to lodging. However, being tall allows these cereals to compete better against weeds. Lastly, he is also breeding 'ancient' grain such as einkorn wheat and emmer wheat. According to current study, people that are sensitive to gluten can consume these grains safely due to the difference in their gluten protein structure. Dr. Sorrells believes that these ancient grains can be an alternative dietary grain for people with gluten-sensitivity. To learn more about Dr.Sorrells' breeding program and his projects visit https://plbrgen.cals.cornell.edu/research-extension/small-grains/

PhD candidate Daniel Sweeney of Dr. Sorrells' research group next to his barley panel. He is developing a high-throughput phenotyping technique for malting quality in barley

After learning about the small grain breeding program, Cornell students prepare some delicious BBQ for dinner.

MSc. student Shanthanu Krishnakumar is satisfied with the food.

Post-dinner entertainment event: Piñata hitting. Dr. Rajcan bravely hold the piñata for the enjoyment of his fellow student.

Ph.D. Student Max Hargreaves was the one to break it!

University of Guelph students showing their support and appreciation for farmers!!

Dr. Mazourek talking about his breeding program.

MSc. student Christine Lee immerses herself in the aroma of basil.

On the second day, we visited Cornell's organic farms. Here we met Dr. Michael Mazourek where he introduced his breeding program which works to adapt vegetable crops to Northeastern US. An important aspect of his work is using a holistic growing approach within an organic system to achieve improved disease resistance and flavour profiles. Two of the crops we were shown included zucchini and basil. Zucchini was first introduced to Los Angeles in the 1920s and therefore has had a relatively short time to adapt to North American production regions. To adapt these varieties Dr. Mazourek takes a staging approach, gradually moving the crop through different production regions and environments. Through this method, he is able to create varieties that benefit from natural selection and require fewer inputs. Dr. Mazourek also works with basil Downy mildew resistance. In herbs, breeding can greatly affect the flavour and texture profiles and therefore must be carefully assessed during the breeding process. We were able to sample different basil plants such as high anise type, or thai basil, as well as those with flavour profiles more traditionally used for pesto making. To learn more about Dr.Mazoureks' research visit: https://hort.cals.cornell.edu/people/michael-mazourek

Dr. Martha Mutschler-Chu talking about the research focus of her breeding program

The second speaker was Dr. Martha Mutschler-Chu and she is working to develop no-spray tomatoes in order to minimize use of copper sprays for bacterial and fungal diseases. She is interested in late blight, early blight, and Septoria leaf spot. These diseases can result in plant death as quickly as 10 days. Her research explores the genetic inheritance of different resistances to these pathogens. Dr. Mutschler-Chu showed us a tomato plant which was a phenocopy for bacterial wilt, a plant which expresses the disease response erroneously due to a genetic mutation. This genetic mutation is linked with her disease resistance genes and she is currently working to break the linkage. Another interesting aspect of her research is a secondary metabolite produced in the wild tomato species *Solanum pennellii,* which acts as a broad spectrum insecticide. This trait has been transferred to field tomatoes and has been shown to have 95-97% control over many insect species, similar to that of chemical insecticides. To learn more about Dr. Martha Mutchler-Chu's research visit:https://plbrgen.cals.cornell.edu/people/martha-mutschler-chu

Tomato plant that was a phenocopy for plant with bacterial wilt

Interest in *Brassica* vegetables has rapidly increased in North American markets as a "superfoods" in recent years. Dr. Phillip Griffith's breeding program works to produce disease resistant varieties of *Brassica* species such as kale, cabbage, and collard greens adapted to local areas. In addition to North American food production, Dr. Griffiths spoke about his work in vegetable improvement in African countries. Kale, or "Sukuma Wiki" is staple food in Sub-Saharan Africa and in the Kenyan translates "to push the week" or "to stretch the week", which highlights its importance as a crop for food security in this region. Dr. Griffiths also notes that *Brassicas* are culturally ubiquitous which is advantageous for his breeding program as it provides diverse germplasm for the production of new varieties.

Dr.Philip Griffith talks passionately about his *Brassica* breeding program in the rain

Dr. Walter De Jong and his potato breeding

The last speaker of the day was Dr. Walter De Jong, who spoke to us about Cornell's potato breeding program. Potatoes in New York State are primarily used for producing chips and the remainder for fresh market sales. The ideal chipping potato is round with light coloured flesh and a high starch content which reduces the amount of oil needed to fry them. In New York state, there is an emphasis for breeding against potato virus Y and golden nematode resistance, the latter of which is only found in NY state. New strains of potato virus Y have shown to cause tuber necrosis and are increasing demand for potato virus Y resistant cultivars. The high heterozygosity shown when breeding allotetraploid potatoes makes progress from generation to generation slow, but the De Jong lab is working to understand the genes at a molecular level to help accelerate traditional breeding efforts.

The second day was finished with a wonderful dinner at Stewart Park and a nice post-dinner walk next to the Cayuga lake.

On the last day of the GLPBI, the Cornell group gave the students a tour at the

Cornell Geneva Experimental Farm.

On our first stop, Dr. Courtney Weber showed us his breeding program for *Rubus spp.* We were shown samples of traditional red raspberries as well as black, purple, 'blush' and yellow raspberries and were encouraged to taste the samples. It was noted that when purchasing raspberries, consumers are looking for a balance between tangy acidity the sweetness of sugars. For texture, large berries with minimal trichomes are desired to enhance the shine of berry. However, as the berry becomes larger the cavity within the berry also becomes larger, making it susceptible to damage during transport. One of the most significant advancements in recent history was cultivating thornless canes in raspberries. The thorns on canes point downwards like claws and can cause significant abrasions to workers picking the raspberries. He showed us the canes of each variety of raspberry and how although raspberries are perennial, the canes can produce fruit only on two-year-old canes (floricanes) or stalks that can produce fruit on one-year-old-canes (primocanes). Dr. Weber also grows raspberries in tunnels that can lengthen the productivity of the raspberries from August-September to September-October by lowering the risk of frost damage. However, this enclosure increases the risk of diseases such as Verticillium Wilt.

Different varieties of raspberries developed within the breeding program

MSc. Student Alexandra Ficht walking inside of the open enclosure used to grow raspberries

Dr. Bruce Reisch's breeding program specializes in the development of wine, juice and table grape varieties. The trait of interest in his program includes winter-hardiness and resistance to diseases such as powdery mildew. DNA markers are used to identify vines that carry genes for

Dr.Bruce Reisch

Grape variety that is highly susceptible to powdery mildew, illustrating the importance of Dr. Bruce Reisch's research on the grape industry

resistance. Dr. Reisch's lab has developed a high-throughput phenotyping method that allows them to efficiently sample Downy mildew on thousands of accessions.

Dr. Susan Brown shared her experience in working as a plant breeder and she emphasized the importance of communication skills when working with partners outside of academic settings. Her breeding program focuses on apple breeding. Her breeding strategy involving higher inputs to saplings has managed to shorten the breeding cycle of apple from 40 years to 11 years. Some of the new varieties released from her program includes SnapDragon and RubyFrost.

Lastly, we ended the trip by visiting the large apple and grape germplasm collection at the Geneva experimental farm. Here the students could appreciate the beauty of diversity in the germplasm collection. Various accessions of grape and apple with interesting phenotypes and flavours were shown. A couple notable examples were the grapes shaped as long fingers and a red-fleshed apple. The red fleshed apple is currently used by cider makers to produce award-winning "rosé" ciders. Most importantly, through this brief visit, students were reminded that genetic diversity is essential to plant breeding and that as future plant breeders, we all hold the responsibility to preserve these genetic resources.

Dr. Jason Londo introduced the grape germplasm collection to the students

The stunning diversity of the grapes in the grape germplasm collection.

Dr. Thomas Chao, the curator of apple germplasm holding an apple variety with red flesh

This blog is co-authored by Andy(Yi) Chen, Christine Lee and Baraka Gitari.

Special thanks to the faculty members and the students at Cornell University for making this year's GLPBI such a success.