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Kirk Broders

Assistant Professor of Biological Sciences, COLSA ~ Mexico

I was able to make my first trip to central Mexico in August 2014, in part due to assistance from the CIE Development Grant, in order to conduct research and develop a collaborative network with agricultural scientists in Mexico. The main purpose of the travel was to initiate a new line of research focused on the evolution of plant-associated microbes with a specific focus on documenting the effect plant domestication has on the associated microbiome of a particular species the common bean (*Phaseolus vulgaris*). Central Mexico is an ideal place to study this phenomenon as it is the center of origin of bean, maize, and pepper, which are now grown extensively in the United States and globally. Interestingly enough, a species native to the northeastern U.S., blackberry, is now grown extensively in the central Mexican state of Michoacán to satisfy U.S. markets during the winter months. The main focus of this trip was to sample research plots that had been established by collaborators earlier in the year, as well as cultivate new contacts with Mexican scientists and students who I may collaborate with in the future.



Dr. Angel Rebollar give Dr. Broders (left) and Calvin Broders a tour a blackberry production facility in Michoacan, Mexico

Dr. Iago Hale (UNH – Biological Sciences) and I have begun investigating the effect crop domestication has on the microbes associated with these plants. Previous research has demonstrated that the common bean center of origin and center of domestication was in central Mexico, making this an ideal site to test our hypothesis. My wife Gloria Iriarte who is currently working with Dr. Hale and a former employee at the International Center for Tropical Agriculture (CIAT) in Colombia where she was a part of the bean breeding program, is also working on the project. Through her connections in the bean community, we were able to make contact with Dr. Jorge Acosta, a bean breeder at the Instituto Nacional de Investigaciones Forestales Agrícolas y Pecuarias (INIFAP) in Celaya, Guanajuato, Mexico. In order to test our hypothesis regarding the domestication effect on plant-associated microbes we set up a simple experiment, which consisted of planting six wild accession of *P. vulgaris* from Mexico alongside six commercial cultivars of *P. vulgaris* developed in the U.S. outside the center of domestication. This experiment was planted in three sites in the Guanajuato state as well as at the Woodman and Kingman Farms operated by COLSA and the NHAES. Dr. Acosta was kind enough to ensure these experiments were planted and then Gloria and I along with our six-year-old son Calvin traveled to Guanajuato from August 16-23 in order to sample these locations.

The state of Guanajuato is located between the arid north of the country and the lush south, and it is geographically part of the trans-Mexican volcanic belt, the Mexican Plateau and the Sierra Madre Oriental. The first three days of our trip consisted of driving to one research site per day, sampling the beans planted in that plot and then searching the surrounding area for wild *P. vulgaris* or other wild *Phaseolus* spp. As we wanted the plots planted in locations which had never been used for agriculture, we had to travel to several remote areas of Guanajuato. This involved driving along narrow bumpy dirt roads through small rural villages with beautiful mountainous backdrops. We were able to cover much of the state of Guanajuato and Dr. Acosta was a very gracious guide providing us with limitless information on the agricultural and cultural history of the region as well as the best spots to stop for *gorditas*, *tamales* and *helado* (ice cream).

After the plots were sampled we spent four more days at the INIFAP campus processing the samples, which involved culturing fungi and bacteria from leaves and roots, extracting DNA from the soil attached to the roots and freeze drying the leaves and roots. Between the lab work, I was able to make a number of new acquaintances including the leader of the Biotechnology program Dr. José Luis Anaya-López. Dr. Anaya-López was nice enough to let us use his lab for DNA extractions. We also talked extensively about viruses that infect pepper and beans and the many problems Mexican growers face trying to control these viral diseases. We think that many new viruses of cultivated beans and peppers may come from wild bean and pepper populations. These conversations lead to discussions regarding future collaborative work on this topic and the potential for student exchange between INIFAP and UNH.

After we finished processing the samples at INIFAP we traveled south the Morelia the capital of Michoacán for five days, where we met up with Dr. Angel Rebollar the small fruit pathologist at the Universidad de Chapingo. I know Dr. Rebollar from our time at The Ohio State University, where we were both graduate students in the department of plant pathology. Michoacán is the agricultural engine of Mexico. It is the largest producer of avocados in the world and supplies the U.S. market with the vast majority of our off-season blackberries, blueberries and strawberries. As the small fruit pathologist Dr. Rebollar is responsible for helping the growers in Michoacán prevent yield loss due to pathogens. We were able to tour the Michoacán campus of the Universidad de Chapingo as well as drive through the major avocado, blackberry, blueberry, and strawberry growing regions and meet many of the growers. The scale of production was impressive and reminded me of California agriculture, which is punctuated by fertile valleys that lie between large mountain chains. As I work on a number of fruit crop diseases here in New Hampshire, Dr.

Rebollar and I were able to discuss at length how we might be able to collaborate in the future. We have decided to begin a project investigating pathogens of blueberry in Mexico and the northeastern U.S. We actually face many of the same pathogens in both locations, but also have several unique pathogens that might someday end up in our respective regions. We also discussed the potential to have Dr. Rebollar or one of his students come spend some time working in my lab at UNH.

Overall my trip was extremely successful as I was able to improve current collaborations as well as cultivate new ones. The evolutionary history of plants in central Mexico in combination with the historical civilizations in this region that domesticated those plants has created a unique site for research on plant domestication and utilizing this information to improve current crops. It is my hope the preliminary data collected along with the valuable collaborations developed will lead to future funding and further visits as well as return visits to UNH by Mexican scientists and students. I am very grateful to CIE for their support and look forward to strengthening the relationship between UNH and Mexican universities and research facilities.



Dr. Kirk Broders sampling a young bean plant in order to isolate the microbial community from the leaves, roots, and soil near the roots of the bean plant



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