

Field Report: Courtney Mathers

I was able to accomplish my fieldwork goals this summer thanks to the CLAG field study award. I conducted my fieldwork in the state of Yucatán, Mexico, where I interviewed Mayan smallholder farmers and collected soil and maize root samples. My master's thesis project seeks to compare Mayan agricultural management practices and their impacts on soil fungi. My project focuses on arbuscular mycorrhizal (AM) fungi for several reasons. First, AM fungi are prevalent in agricultural contexts; these fungi form symbiotic relationships with nearly all crop plants worldwide. AM fungi colonize crops by entering through a plant's roots where they exchange essential plant nutrients for carbohydrates. By providing plants with greater access to phosphorus and other macro and micronutrients, these fungi can survive on carbon sourced from their plant host. In addition to this trade system, AM fungi can provide an array of other benefits to their hosts such as increased resistance to pests and disease and increased access to water in the soil. However, these benefits are not always straightforward, especially in the agricultural context. With the application of inorganic fertilizers, crops are less motivated to trade carbon to the fungi because they have access to ample nutrients. My project seeks to understand this change in symbiosis and its impacts on soil in Mayan milpas. The traditional milpa model of rainfed polyculture has, in many cases, been adapted to include the use of agrochemicals. I hypothesize that in milpas where agrochemicals are applied, AM fungi will have lower colonization levels and will thus not provide other important plant and soil benefits.

When I arrived in Mérida, I rented a car using my award funds. With this rental, I was able to drive from Mérida out to small towns where rural Mayan communities use a range of milpa practices. I traveled to towns on the outskirts of the Reserva Estatal Geohidrológica Anillo de Cenotes, namely: Tabí, Yaxcabá, Sotuta, Muna, and Santa Elena. In these areas I met with

locals and was able to locate farmers with milpas that fit my project's target variables. Finding milpas that fit my criteria took a lot of coordinating with these locals, and it would not have been possible without reliable transportation. After finding the desired milpas, I met with farmers in their fields or in their homes when invited in. There I interviewed them about the practices they use, including the types of agrochemicals used and when/how often they apply them. With their permission, I then collected soil and maize root samples. I bought a cooler using CLAG funds, and I stored the samples in this cooler before taking them back to a refrigerator in Mérida. Given the hot and humid weather in the Yucatán, keeping the samples with living fungi cool was imperative.

While the car rental and cooler were essential to conducting my fieldwork, my favorite things that I spent CLAG funds on were food. I was able to try many local dishes like cochinita pibil, papadzules, and panuchos. After spending long, hot days out in the milpas, sitting down to eat in town or often at a farmer's house was a wonderful way to see how crops grown in the milpas are utilized in the kitchen. In conversations shared during meals, I learned a great deal from farmers about everything from their perceptions of climate change, their views on "traditional" milpas and changing farming practices, and how they felt about teaching their children to speak Mayan dialects.

These conversations and my fieldwork really made me feel grateful to be a geographer. It was a great privilege to learn from those who have such an intimate knowledge of and respect for their agroecosystems. The field study funds from CLAG not only allowed me to collect data for my thesis, but more so, permitted me to gain a deeper understanding of my study area and its rich culture. While my research project is ecologically focused on soil fungi and crop benefits, my interviews and conversations are important to understand what drives and influences the

decisions that farmers make in their milpas. This more nuanced view will undoubtedly help to shape my approach to conducting interdisciplinary and applied research in the future. In the short-term, the CLAG field study award was essential to allowing me to collect data for my thesis research. In the long term, the experiences I had during my fieldwork have motivated me to continue to pursue a career in research that seeks to improve human-environment relationships with solution-oriented research.

Abstract

Keywords: smallholder agriculture, milpa, Yucatán, arbuscular mycorrhizal fungi, glomalin

Arbuscular mycorrhizal fungi (AMF) are components of the soil microbial community that are essential to resilience in agroecology. AMF provide a host of benefits to crop resilience such as increased water retention in the soil, decreased plant pathogens, and increased availability of nutrients, particularly phosphorus. In addition, AMF are the sole producers of the glycoprotein glomalin. Glomalin is responsible for a large percentage of the carbon that is stored in soil through processes of soil aggregation. The influences of management practices on AMF communities are of increasing interest to address the resilience of agroecological systems to climate change impacts. Research on AMF and glomalin dynamics are still lacking in many areas, particularly in the context of indigenous agriculture.

This research analyzes differences in AMF properties between traditional and more intensive forms of agricultural management in Mayan milpas in Yucatán, Mexico. In small Mayan towns south and southeast of the Reserva Estatal Geohidrológica Anillo de Cenotes, ten soil samples and maize roots were collected at random from ten rainfed milpas. A 5 m buffer was used when sampling to avoid edge effects. Milpas included in this study were all planted at the start of the rainy season with maize, squash, and legumes. Prescribed burns and the use of agrochemicals were the two selected independent variables in this study. AMF characteristics and soil properties will be analyzed to compare differences in overall indications of soil resilience between the traditional and more intensive forms of management practices. AMF analyses will include the following: percent maize root colonization of AMF, AMF spore density, and concentration of glomalin related soil protein (GRSP). Soil properties being analyzed include percent soil organic carbon, pH, electrical conductivity, aggregate stability, and particle size analysis.

This extended abstract is not yet extended out to include my results and a discussion of those results because I am currently running the aforementioned analyses. I plan to present my preliminary findings in January.



These orange bins outside of the house are where compost for a milpa is produced using kitchen scraps and other organic amendments.



Me (Courtney Mathers) standing in a milpa very happy to have my hands full of soil samples



Me (Courtney Mathers) measuring the height of a maize plant before collecting a root sample.



A typical milpa with intercropped maize, squash, and beans.



Holding maize roots that will be used for analysis of arbuscular mycorrhizal fungi colonization.



The maize here was toppled over due to Hurricane Grace that had passed over the area a few days prior.



A common sight in fields where agrochemicals are used.



Maize root samples stored in ethanol back in the lab in Mérida.



Me (Courtney Mathers) standing in front of the rental car before a day of fieldwork.