Sustainable Agriculture and Natural Resource Management
Collaborative Research Support Program

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Trip Report: Ecuador

March 3 – 10, 2012

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Purpose:

1. View CAPS field experiment sites, discuss modifications to soil and biomass sampling protocol due to drought, and resource limitations.
2. Introduce new graduate student, Kathleen Webber, to INIAP collaborators, discuss involvement and contributions of Kathleen in ongoing SANREM research, discuss possible additional greenhouse experiment, make arrangements for future 2 month stay.
3. Collect soil samples from both CAPS experiment sites to bring back to PSU for soil characterization and P sorption/desorption studies.

Sites Visited: INIAP Santa Catalina research station and CAPS field experiment sites in Illangama and Alumbre subwatersheds in Bolivar province.

Description of Activities:

Summary of Accomplishments.

1. On-site review of the CAPS field experiments at the Illangama and Alumbre sites, and discussion of problems and potential resolutions.
2. Kathleen Webber, a Penn State MS Soil Science student was introduced to INIAP collaborators, received a complete review of the CAPS experiments, and visited all field experiment sites. Made plans for an extended (~2 mo) visit by Kathleen Webber and discussed her involvement with the CAPS experiments and a greenhouse experiment to investigate phosphorus fertility problems in the andic soils of Illangama and Alumbre.
3. Soil samples were collected at the Alumbre and Illangama field sites and returned to Penn State University for soil characterization and initial laboratory investigation of phosphorus sorption/desorption.

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In October, 2011 Ms. Kathleen Webber, a MS student in Soil Science was recruited to join the SANREM project, and to focus her MS research on the Ecuador CAPS. A major objective of this trip was to introduce her to our INIAP collaborators and to work out with them how Kathleen could become integrated into, and contribute to the CAPS research effort. We agreed that she could most effectively contribute by working with INIAP scientists on data reduction and data analysis during a longer term return visit. The project also has a large backlog of soil samples in storage that are awaiting analysis and Kathleen may also be able to contribute to that effort during a longer term visit. Kathleen is fluent in Spanish so the language barriers that prevent me from communicating freely with our collaborators are nonexistent for her.

Additionally, we discussed with Victor Barerra, Soraya Alvarado and Franklin Valverde our interest in Kathleen conducting some initial laboratory and greenhouse research related to phosphorus fixation and fertility, a major problem in the andic soils of Illangama and Alumbre and most of the Andean region of Ecuador. While liming andic soils has sometimes shown to improve P fertilizer efficiency and availability, the large lime application rates required coupled with severe constraints on transporting such large quantities make broadcast lime applications impractical. The tillage required to mix lime into the soil would also be counter to the primary CAPS objectives of reducing tillage and maintaining more soil cover to reduce erosion. We would like to investigate a liming placement technique that could increase P fertilizer efficiency and yet would be compatible with and contribute to CAPS. Because P fertilizer is band applied below seed potatoes and maize seed at planting, our idea is to determine if band application of relatively small amounts of lime with the P fertilizer would reduce P fixation and improve P fertilizer availability. This would entail transporting relatively little material and no increase in tillage. Victor and Soraya were both very supportive of Kathleen conducting some initial laboratory and greenhouse research on this question. But indicated they could not absorb the costs associated with conducting these experiments.

During our subsequent field visits to each experiment location we collected soil samples that Kathleen brought back to our lab at Penn State. She will conduct initial soil characterization, P sorption/desorption experiments and P fractionation assessments with these soil samples. On the last day of our visit we discussed in greater detail with Soraya a possible short-term greenhouse experiment that Kathleen might conduct at INIAP Santa Catalina, if the preliminary laboratory investigations she conducts at Penn State show promising results. We estimated the cost to conduct the greenhouse experiment would be $4,000. The bulk of those funds would be for a modest stipend for an undergraduate student who would assist Kathleen and who would also gather materials before her arrival and complete the experiment after her departure. The other major expense would be for soil and plant tissue analysis. Assuming these funds can be obtained, we are proposing that Kathleen return to Ecuador for a two month period beginning about the third week of June, 2012 to conduct the greenhouse experiment and to work on the data analysis tasks mentioned in the first paragraph above. Both Soraya and Victor graciously offered that Kathleen could stay in their homes during this period as other suitable housing options are not available on or near the Santa Catalina station.

We travelled with Victor and Franklin to Guaranda where we met up with Luis and the rest of the field crew. We spent one day each at the CAPS experiments in the Illangama and Alumbre sub-watersheds. At each location there are three experiments: old, new, and the former small

erosion plot experiments. At each location we discussed progress and problems with the experiments and conducted soil and biomass sampling on the experiments.

One problem the Ecuador team has is that the intensity of sampling on multiple experiments is outpacing their resources to collect and analyze the samples. To address this problem Victor and Franklin want to decrease frequency of soil sampling to measure biomass mineralization from every 15 days to every 30 days. The opinion I expressed was that while it would be nice to have the mineralization data, given the reality of resource limitations it made sense to eliminate these samples as opposed to other more critical data. Also related to resource limitations is the large backlog of soil samples the Ecuador team has stored that are awaiting analysis primarily for N and PMN. Once Arnulfo Portilla completes his undergraduate work this spring he will be employed full time to work on sample analysis for the SANREM project and will start to whittle down the sample backlog. The team also needs to get the microplate reader that Rob Gallagher delivered on his last visit up and going. Some of the essential chemicals ordered for the microplate N analyses are apparently still tied up customs. It is very important that these hurdles get resolved and so the lab can commence with the microplate reader based analyses.

The other major problem with the Alumbre experiments was a drought that occurred during the natural pasture and oat/vetch rotation of the experiments there. This resulted in almost no natural pasture establishment and very poor oat/vetch stands with extreme variability. Because of this the team decided to conduct only one biomass sampling of these stands which was done at the time herbicides were applied.

Soraya also raised the question of the digestion method she should use for total P analysis, the options being carbonate fusion, perchloric acid digestion, alkaline oxidation or an aqua regia-type strong acid digestion. She would prefer not to do carbonate fusion because it is time consuming and they have only 3 platinum crucibles. Her lab has perchloric hoods and could use that procedure. But because the Bolivia team (and likely other SANREM locations) does not have that capability I suggested we may need to use one of the other options. I told her I would discuss the matter with Rob Gallagher and Mike Mulvaney.

Despite the above problems, I think that overall the Ecuador team is doing a very good job of conducting the CAPS experiments. The experiments are well maintained and they appear to have a good system in place for sampling and maintaining sample integrity.

Suggestions, Recommendations and/or Follow-up Items

1. Microplate reader based N analytical capability of the Soil lab at Santa Catalina needs to be fully developed. This should be a priority for Rob Gallagher on his next visit. All necessary reagents need to be on hand so that Rob can train key INIAP staff on using the instrument and the basic protocols.

2. Kathleen Webber should return to Ecuador for a two month stay in summer 2012 to work on the two tasks listed below.
    a. As Rob noted in his last trip report, development of a transparent data management system and process for data reduction and analysis needs to be implemented. During his

next visit Rob could lay the groundwork for this, and Kathleen could then continue to work with INIAP staff on implementing the process during her two month stay.

b. Conduct a greenhouse experiment with soils from Illangama experiment site to investigate the potential for band applied lime and P to mitigate P fixation and improve P fertilizer efficiency.

Appendix 1: Log of Activities

Saturday March 3, 2012
Stehouwer departed Grand Rapids for Quito, Ecuador via Chicago and Miami. All flights on time. Webber departed Washington Dulles for Quito, Ecuador via Miami and due to a flight cancellation and delays did not reach Quito until 1:30 am Sunday.

Sunday March 4, 2012
Rest and recovery day in Quito.

Monday March 5, 2012
Spent the morning at the INIAP Santa Catalina research station with Victor Barrera, Franklin Valverde, Soraya Alvarado and Arnulfo Portilla. Victor and Franklin provided us with a complete overview of all CAPS experiments and Soraya and Arnulfo described the sample analysis they were doing. We also had a tour of the soil lab. In addition we had some preliminary discussions of how Kathleen might be able to become involved in the CAPS experiments, the P fixation problems she was interested in studying, and the possibility of her returning in the summer for a two month stay. In the afternoon we travelled to Guaranda with Victor and Franklin.

Tuesday March 6, 2012
Visited the Illangama sub-watershed experiments. Collected soil and biomass samples. In the afternoon accompanied Victor to Universidad Estatal de Bolivar where he gave a seminar to the faculty.

Wednesday March 7, 2012
Visited the Alumbre sub-watershed experiments. Collected soil samples. Kathleen was sick with a stomach bug but was a trooper and made the trip anyhow.

Thursday March 8, 2012
In the morning we met with the field crew in the Guaranda INIAP office to review some experiment details and packed up samples from the experiments and our soil samples for transport to Santa Catalina. In the afternoon we travelled to Quito and dropped off samples at Santa Catalina, spread out our soil samples in a greenhouse to dry.

Friday March 9, 2012
Returned to Santa Catalina. Screened, weighed and packaged our soil samples for transport to the US. Met with Soraya to discuss Kathleen's potential contributions to the CAPS experiments, in

particular to data reduction and analysis. Also discussed with her the details of a greenhouse experiment that Kathleen could conduct, the logistics and the estimated costs.
In mid-afternoon Victor took us to Otavalo to visit the market there.

Saturday March 10, 2012
Departed Quito for Miami. No problems with soil sample hand carry import. Webber continued to Dulles. Stehouwer stayed overnight in Miami.

Sunday March 11, 2012
Departed Miami for Grand Rapids, MI via Dallas. Drove to State College from Grand Rapids.