



Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program

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Trip Report: Bolivia & Ecuador

19-27 February (Bolivia) and 27 February-8 March (Ecuador) 2011

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Purpose of Trip: Visit with PROINPA and INIAP collaborators to view the SANREM field sites and review soil and plant sampling regimes and protocols.

Sites Visited: PROINPA Cochabamba, Bolivia; Tiraque region, Bolivia; INIAP Santa Catalina and Guaranda, Ecuador; and Santa Domingo, Ecuador

Description of activities:

Summary of Accomplishments - Bolivia: The main accomplishments in Bolivia include 1) training of the host country collaborators (Botello, Saavedra-Rivera, and Gutierrez) in the soil extraction/preparation procedures for Mehlich III, inorganic N, and particulate organic matter (POM); 2) review and test run of the hydraulic conductivity and water holding capacity (i.e. tension table) protocols; 3) assessment of the instrumentation capabilities to run colorimetric nitrate, ammonium, and available phosphorus measurements; 4) on-site review of the primary long-term CAPS and associated tillage/cover crop experiments at Tiraque; 5) on-site review and discussion of establishment of CAPS and associated satellite experiments at the other three field locations, and 6) on-site review of locally manufactured equipment for conservation tillage systems. Further training is needed in the spectrophotometric analysis of inorganic N and available P, water infiltration procedures, and soil and plant material preparation for total C & N content. In addition, Botello requested further assistance in the design and implementation of the satellite tillage and cover crop experiments, as well as data management/analysis.

Summary of Accomplishments - Ecuador: The main accomplishments in Ecuador include 1) construction of a prototype apparatus to run hydraulic conductivity measurements on soil cores; 2) review of the necessary materials and construction specifications for a tension table apparatus;

3) review and discussion of potential protocols to evaluate labile organic N; and 4) on-site discussions on the necessary changes needed for the on-going Surface Water Management and Erosion Plot Experiment; 4) review and discussion of the design and implantation of the new long-term CAPS experiment (integration of reduce tillage and cover crop factors) . Further input was requested by Drs. Alvarado and Barrera on the necessary instrumentation to accomplish the measurement of inorganic N and available P using microplate technologies.

Observations: Bolivia

The early spring drought in Tiraque region of Bolivia followed by the cold and wet weather has hampered the initiation of the CAPS experiments at three of the four sites. Although the forage treatments will need to be reestablished next spring, the experimental layout and baseline soil samples can still be utilized in two of the three lost sites. Extensive erosion of the fourth site will necessitate that the experiment be completely redesigned. The successful lower altitude site in Tiraque looks quite good despite the poor spring and summer growing conditions.

Team Bolivia has made excellent progress in establishing a small, but adequate soil and plant processing lab. With the appropriate upgrades of their microplate reader, they will be well positioned to do their own labile N and available P measurements. Given that all of these protocols are new to the Team, continued guidance from Gallagher and Stehouwer is essential. Arrangements to do total C, N and P still need to be made.

Ruben Botello of PROINPA has done an excellent job at leading his team in the procurement of the field sites, establishment of the soils lab, and the initiation of the soil sampling procedures.

Observations: Ecuador

The field experiments all appear to be in very good order and most of the preliminary soil samples have been taken. Under the guidance of Dr. Alvarado, the analysis of the soil and plant samples should go very well. Dr. Alvarado has made a tentative agreement with Dr. Barrera to purchase a microplate reader, which will greatly reduce the time and money associated with doing many of the nitrogen and phosphorus measurements. I am working with them to help identify an economical instrument.

Victor Barrera has done an excellent job at assembling a highly capable and enthusiastic INAIP team for the SANREM project.

Alejandro Rafael Naranjo Salga, a student University of San Francisco in Quito is planning on starting his M.S. degree at Penn State in the Fall semester of 2011 with Rick Stehouwer as his primary advisor. His program is to be funded in part by the PSU SANREM program, with support also coming from the Department of Crop and Soil Sciences at Penn State. Alejandro has taken and passed (according to PSU requirements) his TEOFL test, and has taken his GRE test and is awaiting his test scores. Alejandro is keen on participating in some aspect of the Ecuador-based SANREM project, with a potential interest in pesticide and nutrient fate in CAPS systems. Dr. Alvarado's participation (i.e. in-country advisor and graduate committee member) I believe to be essential if he is to do any of his research in Ecuador.

Suggestions and Recommendations

1. Gallagher needs to identify the specific upgrade configuration for PROINPA's microplate reader to enable the colorimetric measurement of inorganic N and available P.
2. Gallagher will work with Botello of PROINPA to identify cold tolerant legume species to be integrated into CAPS systems.
3. Gallagher will work with Mulvaney to identify alternative protocols for measuring labile organic N in soils.
4. Gallagher will work with Dr. Alvarado to identify an economical microplate reader for her lab.
5. The Penn State based SANREM team needs to discuss the integration of the CAPS and microbial ecology aspects of the project.

List of Contacts Made:

Name	Title/Organization	Contact Info (address, phone, email)
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Appendix: Daily Log

Saturday, February 19

Attempted to depart from State College, PA, but initial flight was delayed, and the departure postponed until the following day.

Sunday, February 20

Departed from State College without issue, making connections in Philadelphia and Miami.

Monday, February 21

Arrived in La Paz, but checked bag containing laboratory supplies did not. Continued on to Cochabamba via BoA airlines.

Traveled to the PROINPA station to discuss the recent progress on the SANREM project with the project collaborators (Ruben Botello, Ana Karina Saavedra Rivera, and Oscar Gutierrez) to formulate a schedule for the week.

Tuesday, February 22

We had initially intended to travel to the field sites near Tiraque, but the public transportation strike prevented this activity. Instead we worked in the laboratory to

review the soil analysis protocols. Specifically, we worked on the sample preparation for the inorganic nitrogen, exchangeable cations, and particulate organic matter POM analysis. All the baseline soil sampling we discussed during my October 2010 trip had been completed.

Wednesday, February 23

Continued to review of the soil analysis protocols in the morning, including the protocol for potentially mineralizable soil nitrogen (PMN).

Travelled to the field sites near Tiraque that afternoon. Of the four experimental sites previously identified, the site in Tiraque looked the best. At this site four CAPS experiments have been established. The CAPS experiments include 1) vetch cover crop and inclusion in a potato – quinoa – fava bean rotation 2) supplemental fertility management for the potato phase of the potato – quinoa – fava bean rotation, 3) reduced tillage potato trial, and 4) alternative forage options to proceed the potato-based systems. All four of these experiments are in quite good order. I emphasized that given the high accessibility of this site, efforts should be made to showcase the experiments. Such efforts could include signs for plots, establishment of grass in the walkways, and agroforestry-type demonstrations. All team members concurred with these suggestions. The experiments in the other three higher elevation sites have not done well due to the over two month delay in the spring rains, followed by unusually cold and wet weather. It was decided that the establishment of the CAPS experiment should be attempted again next year

Thursday, February 24

Finished the review of the PMN procedure.

Disassembled the microplate reader to evaluate the potential to upgrade this instrument to be able to do colorimetric analysis of soil nutrients (nitrate, ammonium, and available P). It was decided that I would take the photometer from the instrument back to the US with me and do the upgrade there.

Conducted a test run of hydraulic conductivity and water holding capacity procedures measurements introduced to them by Rick Stehouwer of Penn State.

Friday, February 25

Finalized the procedures for the evaluation of the soil physical properties and reviewed the sequence of steps for the entire soil analysis procedure. There are limited capabilities at PROINPA to conduct the total carbon, nitrogen and phosphorous analysis. We discussed the possibility to establish collaboration with the Ecuador SANREM team at INIAP.

Visited the Centro de Mechanacion Agricola in Cochabamba. This institute is affiliated the university in Cochabamba, but also produces machinery for retail sale. One aspect of their work is to develop agricultural equipment for animal traction systems. They have a very interesting suite of grain drills, tillage and harvesting equipment designed for the small farmer. The professor in charge seemed quite willing to collaborate with our SANREM project. However, the availability of funding may be an initial obstacle.

Departed for La Paz.

Saturday, February 26: Day off.

Sunday, February 27

Departed for Quito via Lima Peru on TACA airlines. Was greeted at the airport by Victor Barrera. Mike Mulvaney from the SANREM ME arrived that night. He transported the soil sampling equipment purchased by the Penn State SANREM project.

Monday, February 28

Gallagher and Mulvaney traveled to the Santa Catalina INIAP station with Franklin Valverde. Visited with Dr. Soraya Alvarado of INIAP to discuss the collaboration between her and Dr. Victor Barrera regarding the analysis of the soil and plant samples from the SANREM project.

Travelled to Guaranda

Tuesday, March 1

Visited all the SANREM-related field sites for the lower watershed experiments (Surface Water Management Experiment (i.e. perennial strip and tillage factors are confounded), Erosion Plot Experiment, CAPS experiment). The pasture and forage components of the experiments are well established, and the tillage regimes will be implemented in the next month. Maize will be the initial crop in the rotations for most of these experiments.

Mulvaney took GPS coordinates for all replicates of the CAPS experiment.

Wednesday, March 2

Visited all the SANREM-related sites for the upper water shed experiments. The design of these experiments is similar to the experiments in the lower watershed, except potatoes is the primary crop. Again, all the forage and pasture components for these experiments are in place, and the tillage regimes will be initiated within the month.

We discussed the design problem (i.e. confounding tillage and water management treatments) for the surface water management experiment. We agreed to remove the drainage ditch components of the experiment.

Demonstrate the use of the soil sampling equipment. Returned to Quito

Thursday, March 3

Worked with Franklin Valverde and the students associated with SANREM project on building the hydraulic conductivity apparatus similar to what was built in Bolivia in October.

Discussed the details of the soil analysis protocols with Dr. Soraya Alvarado. All the baseline soil sampling we discussed in October had been completed, and Dr. Alvarado had supervised the initial laboratory analysis. Her data on the PMN protocol raised issues with that approach to estimating labile organic N. As such, Mulvaney and I agreed to look for alternative protocols.

Friday, March 4

Toured farm sites and markets with Victor Barrera. Mulvaney departed Quito

Saturday March 5 – Monday, March 7

Visited oil palm, cacao and plantain farms in the Santa Domingo coastal region of Ecuador.

Tuesday, March 8

Departed Quito to return to State College