Sustainable Agriculture and Natural Resource Management
Collaborative Research Support Program

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Trip Report: Ecuador

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Purpose:

1. Review CAPS field experiments, particularly progress on sample collection and analysis.
2. Establish a data sharing and data analysis and interpretation system accessible to all project participants.
3. Outline publications to result from CAPS experiments and assign primary responsibility for those publications.
4. Conduct final soil sample collection from the micro-liming greenhouse experiment, review analytical results to date and make any needed modifications to sample analysis.
5. Discuss possible field experiment as a follow-on to the greenhouse micro-liming experiment.

Sites Visited: INIAP Santa Catalina research station.

Description of Activities:

Summary of Accomplishments.

1. We met with Victor Barerra, Soraya Alvarado, Franklin Valverde, and Arnulfo Portilla and carefully reviewed all data that has been collected to date in the CAPS experiments and established a time-line for completion of all sample analysis.
2. We used Google Drive to set up a system for sharing all project data and data analysis and interpretation. All Ecuador project participants now have access to and understand how to upload and share data files. Only Victor and Soraya will be able to edit primary CAPS data files for the Ecuador experiments. All project participants will be able to view and download primary data. All project participants will be able to upload data analysis and interpretation files.
3. We discussed several refereed journal publications that should result from the CAPS experiments in Ecuador. We agreed on 3 articles covering the soils/agronomic aspects of the

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CAPS experiments; one relating to N cycling and availability, a second relating more generally to changes in soil quality, and a third relating to the cropping systems. A fourth article would relate to the economic aspects of CAPS in our study areas, while a possible fifth article would address farmer adoption of CAPS. The need for extension publications to explain and promote CAPS was also discussed though we did not specifically outline what those might be.

4. Our review of very limited data available from the micro-liming experiment indicated there has not been an effect of micro-liming on P availability or barley growth. We uncovered a fundamental error that had been made in setting out the treatments which confounded the experiment and limits its ability to address our fundamental hypothesis. To address this problem we outlined a second greenhouse study that will be conducted in the next 4 months.
5. Soil samples from the greenhouse experiment were collected and returned to Penn State University for laboratory investigation of phosphorus sorption/desorption and phosphorus partitioning analysis.
6. Given the lack of lime-P interaction observed in our limited greenhouse experiment data and the need to conduct a second greenhouse experiment we decided we should not seek SANREM funding to conduct a follow-on micro-liming field experiment.

We spent the entire week of our visit working at the INIAP Santa Catalina station with our Ecuadoran collaborators; Victor Barerra, Soraya Alvarado and Franklin Valverde. Given that the purpose for the trip focused entirely on sharing and utilizing data generated by the experiments we decided that devoting two days of travel to and from the CAPS experiment sites was not warranted. The micro-liming greenhouse experiment is also being conducted at the Santa Catalina station and we needed to spend a full day working on the final soil sample collection from that experiment and packaging the samples for transport to Penn State.

Our first two days were devoted entirely to reviewing all data collected to date from the 4 CAPS experiments in Illangama and Allumbre. The most complete data set at this point is from the new experiment in Allumbre. That is because this experiment is the basis for Arnulfo Portilla's undergraduate thesis work and he spent most of his time analyzing samples from that experiment. He has now graduated and is working full-time on sample analysis from the other experiments. Progress on that front is very good and Arnulfo is a highly competent analyst. Soraya expects to be caught up with all sample analysis by March 2013.

Our discussion brought to light some problems with the CAPS experiments that need to be addressed as we move forward. One is that most seedlings of oats/vetch cover have resulted in much greater oat than vetch cover and biomass production. Also drought in the Alumbre region affected the oat/vetch stands on some plots. This of course has consequent effects on biomass mineralization and N availability to the subsequent crop. Franklin plans to increase the amount of vetch in the seeding mix to hopefully increase the amount of vetch in the cover stand. Franklin would also like to follow the 3rd oat-vetch stand with maize rather than going back to beans so that we get another (and hopefully better) test of maize response to N derived from the oat-vetch cover. Sampling intensity is taxing the capacity of the field crews, and also then increases the sample analysis burden for the soils lab. We discussed with Franklin and the rest of the group some options for decreasing sampling intensity for the mineralization assessment. On the Alumbre experiments, mineralization sampling in maize following oat-vetch cover will be

reduced to: at planting; 45 days after planting; at flowering; and at harvest. Three depths will be sampled at the first date and only the upper 2 depths (0-5, 5-10 cm) at subsequent dates.

We spent another half day working on the Google Drive based file sharing system for sharing primary data files as well as data analysis and interpretation files among all project collaborators. The folder hierarchy has main folders for Ecuador and Bolivia. Within each country folder are two sub-folders; one for primary data and another for data analysis and interpretation. For Ecuador CAPS experiments only Victor and Soraya have editor rights to the primary data folders. So only they can place data files in these folders or edit data files in these folders. They will also place complete descriptions of experiments as well as sampling and sample analysis protocols (Materials and Methods) in the primary data folders. All project collaborators are able view and download data files. All project collaborators are able place data analysis and interpretation files in the analysis and interpretation folders. By the end of the morning everyone had access to Google Drive, had established synchronization with their computers, and had learned how to use the system. This data and analysis sharing system should greatly facilitate collaborative work on publications.

We also discussed ideas and strategies for refereed journal articles and extension publications for the project. There was agreement that the strongest publications would result from topical or thematic articles that utilized data from all four CAPS experiments, rather than articles based on individual experiments. We came up with three articles from the soil/crops (physical science) aspects of the CAPS experiments. One would focus primarily on nitrogen in the CAPS system (N inputs, N mineralization, N availability and uptake by subsequent crops). Another would focus primarily on CAPS impacts on soil quality and erosion (biomass and C balances, soil quality indicators). The third article would focus on the overall cropping systems (production, sustainability). Soraya would like to take the lead on the first two (with significant collaboration from Rick, Rob and Franklin), and I recommended that Rob Gallagher should take the lead on the third article. A fourth article would relate to the economic aspects of CAPS in our study areas, while a possible fifth article would address farmer adoption of CAPS. Victor will work with Jeff on these articles. The need for extension publications to explain and promote CAPS was also discussed though we did not specifically outline what those might be. Franklin and Victor agreed they should take the lead on extension publications. We did not discuss possible publications that would bring together our work in both Ecuador and Bolivia. One problem related to publication brought up by Victor, Soraya and Franklin is that they have extremely limited access to the scientific literature, particularly on-line access to a broad array of journals that US based collaborators have via their University Library systems. I agreed to check with Jeff to see if there is any possibility that SANREM could provide access via VT libraries.

Two full days were devoted to the micro-liming and phosphorus availability greenhouse experiment that Katie Webber worked on during summer 2012 together with Soraya, Franklin and several other helpers from INIAP. We had only a very limited data set to look at; two sets of soil P extractions and barely biomass production. We reviewed those results, spent a full day conducting the final soil analysis for the experiment, and had a long discussion of whether or not we should request additional funding from the SANREM ME to conduct a follow-on field study. The limited initial data from the experiment indicates no effect of liming on subsequent P availability. However, I also discovered an error was made in setting up the fertility treatments in

the experiment. Rather than P being the only fertility variable, with other nutrients being uniform across all treatments, all nutrients (N, K and S) were added or not added together with P. Therefore the experiment is confounded and we can really only compare treatment 1 with treatment 2 (control vs. lime only) and treatment 3 with treatment 4 (P vs. P+lime). We also reviewed several long-term field liming experiments Franklin and Victor have conducted at various locations in Ecuador which do indicate lime and fertility interactions. After much discussion we finally decided we should not rush into a field experiment at this point. Rather we would conduct a smaller and shorter second greenhouse experiment to better test the lime and P interaction. Because the student intern hired to work on the greenhouse experiment will be working through May he will be able to conduct the second experiment. By cutting back on the number of soil analyses conducted for the first greenhouse experiment we can cover the analytical costs of the second experiment with existing funds. Victor and Franklin will be visiting several farms in the Illangama watershed next week and will sample fields on those farms to find a soil that is both low pH and low P. This soil will be used for the second greenhouse experiment. This will be a factorial experiment with 3 rates of lime and 3 rates of P addition. The plan is to start the experiment in early January, 2013 and complete it by April, 2013.

Suggestions, Recommendations and/or Follow-up Items

1. Change oats/vetch seeding ratio to get better balance of oats and vetch biomass in cover crop stands. Change rotation of Alumbre experiments to plant maize following the third planting of oats/vetch. Stehouwer will discuss these changes with Gallagher.
2. Decrease sampling intensity for mineralization assessment to ease sampling load on field crew and to decrease number of samples to be analyzed. Stehouwer will discuss these changes with Gallagher.
3. Follow-up with all project participants to insure the file sharing system is being utilized and data files uploaded in a timely manner. Begin to work on data analysis, interpretation and publications. Stehouwer will discuss CAPS publication plans with Gallagher.
4. Conduct second greenhouse experiment to investigate lime and P fertilizer interactions with respect to P availability in Andisol soil from Illangama watershed.

Appendix 1: Log of Activities

Saturday November 17, 2012

Travel day from Michigan (Stehouwer) and Pennsylvania (Webber) to Quito, Ecuador. Arrived on time with no problems.

Sunday November 18, 2012

Rest and recovery day in Quito.

Monday November 19, 2012

Met at the INIAP Santa Catalina research station with Victor Barrera, Franklin Valverde, Soraya Alvarado, and Arnulfo Portilla. Reviewed Alumbre Old and New CAPS experiments and sample analysis and data completed to date. Arnulfo gave us a presentation of his undergraduate thesis which utilized data from the New CAPS experiment in Alumbre watershed.

Tuesday November 20, 2012
Met at the INIAP Santa Catalina research station with Victor Barrera, Franklin Valverde, Soraya Alvarado and Arnulfo Portilla. Reviewed Illangama Old and New CAPS experiments and sample analysis and data completed to date. Discussed problems encountered in all experiments and possible solutions.

Wednesday November 21, 2012
Met at the INIAP Santa Catalina research station with Victor Barrera, Franklin Valverde, Soraya Alvarado and Arnulfo Portilla. Discussed the Google Drive file and data sharing system. Worked out a folder hierarchy, got all project participants connected to Google Drive and familiar with how to use it. Discussed publication strategy. Began to review results from micro-liming greenhouse experiment.

Thursday November 22, 2012
Worked on soil and barley biomass sampling from the greenhouse micro-liming experiment.

Friday November 23, 2012
Weighed and packaged our soil samples from greenhouse experiment for transport to the US. Met with Soraya to make plans for follow-up greenhouse experiment.

Saturday November 24, 2012
Departed Quito for Miami. No problems with soil sample hand carry import. Webber continued to Pennsylvania, Stehouwer continued to Michigan.