Report on Travel to Brazil, South Africa and Philippines
7 - 31 March 1999
USAID Grant No. LAG-G-00-97-00002-00
SM-CRSP Project *Decision Aids for Integrated Soil Nutrient Management*

Traveler: T. Jot Smyth - North Carolina State University
Objectives:

In order to ensure that decision support system software for integrated soil nutrient management is user-friendly and has user-value, the software must be piloted under a variety of location-specific conditions. Our project does this via an extensive network of evaluators in tropical Africa, Asia and Latin America. Network evaluators also have soil nutrient management knowledge, and field-laboratory data sets that need to be explored and incorporated into the decision support system software whenever appropriate. Travel to Brazil and South Africa focuses on initiating interactions with evaluators in the extensive network.

Travel to the Philippines will be Smyth's first visit to the project's intensive testing site near Ilagan, Luzon and is a cost-effective addition to this trip. Preliminary discussions with PhilRice will also set in motion development of plans to hold a workshop at their facilities on decision processes for integrated nutrient management during the latter half of year 3.

Specific travel objectives are to:

- conduct preliminary evaluations of project software and become familiar with soil nutrient management knowledge and experiences among extensive network collaborators in the Cerrados of Brazil and the KwaZulu-Natal region of South Africa,
- become familiar with the project's intensive testing site, ongoing core experiments and on-farm trials at Barangay San Antonio, Philippines, and
- initiate discussions with PhilRice about using their facilities for a project workshop in the latter half of year 3.

Itinerary:

Sunday, March 7 - Monday, March 8	Travel from Raleigh to Viçosa, Minas Gerais, Brazil
Tuesday, March 9 - Tuesday, March 16	Meetings with faculty and students of the Soil Science Dept., Fed. Univ. Viçosa; seminars and demonstrations of IntDSS software; visit to Cenibra Eucalyptus farms and paper pulp production facility
Wednesday, March 17	Travel from Viçosa to Brasília, Brazil
Thursday, March 18 - Friday, March 19	Meetings, seminar and IntDSS software demos with EMBRAPA/CPAC soil scientists; visit to USAID office
Saturday, March 20	In Brasília
Sunday, March 21 - Monday, March 22	Travel to Pietermaritzburg, South Africa

Tuesday, March 23 - Wednesday, March 24	Seminar and meetings with soil scientists at Cedara Agric. Exp. Station
Thursday, March 25 - Friday, March 26	Travel to Manila, Philippines; visit to USAID office; travel to Philippine Rice Research Institute in Maligaya
Saturday, March 27	Meetings with PhilRice scientists and tour of facilities
Sunday, March 28 - Monday, March 29	Travel to Ilagan, Isabela; tour of project activities at Barangay San Antonio; return to PhilRice and continued to IRRI, Los Baños
Tuesday, March 30	Visit to IRRI, Los Baños
Wednesday, March 31	Return trip to U.S.

Brazil:

Federal University of Viçosa (UFV)

IntDSS

I presented a seminar twice describing our project's 5-year workplan and the structure of the IntDSS software. The first presentation was to the Soil Science Department's faculty and graduate students involved with compilation and assembly of data for eventual development of computer programs for nutrient recommendations on the major crops grown in the region. The second presentation was to the entire Soil Science Department.

In several small-group settings I also demonstrated the 'pre-beta release' of the IntDSS software prototype. This release contained a fully functional version of the acidity module (diagnosis, recommendation and guidance); although the N and P modules were not fully functional, development of the software shell was sufficient to provide users with an idea as to how the other modules would operate when implementation was complete. I also used Russ Yost's PDSS2 to illustrate concepts of a) cumulative probabilities for nutrient diagnosis and b) the use of graphical images for nutrient deficiency symptoms and indicator plants.

Faculty and students were particularly interested in the approach we propose to use in compiling published data for crop requirements for N, responses to fertilizer N and N contributions from preceding leguminous crops (see project report entitled "NDSS Algorithms for Corn" at *http://intdss.soil.ncsu.edu/sm-crsp/Download/Download.htm#Downloadable Project Activity Documents*). There was considerable discussion in how the same approach could be used in their efforts to synthesize regional data on major crops for their software development efforts.

Interest was also evident for the modified version of the Cochrane et al. (1980) algorithm used by IntDSS to assess acidity constraints and provide lime recommendations based on crop tolerance to Al saturation % of the effective CEC. Current approaches used at UFV consist of lime recommendations based on exchangeable Al plus an adjustment to ensure that lime provides a minimum soil level of exchangeable Ca and Mg. Failure to adjust lime recommendations to obtain a minimum level of soil Ca and Mg is of particular importance to sandy soils with low

effective cation exchange capacity (ECEC) where lime recommendations to neutralize exchangeable Al may not provide sufficient Ca and Mg for some of the intended crops.

UFV uses the same extractants for measuring soil P availability as those contained in IntDSS. Their recommendations for crop P requirements also recognize that critical soil P levels and 'fertilizer P recovery by the extractant' (this is the same as the IntDSS P buffer coefficient - change in extractable soil P/unit of added P) changes with the soil's P sorption capacity. However, they have not been satisfied with adjusting critical levels and fertilizer P recovery by soil clay content alone. In order to account for influences of clay mineralogy on variations in P sorption capacity in soils with similar clay contents, UFV has implemented a single-point P sorption measurement in their routine soil testing program. Equilibrium solution P is measured after shaking soil for 1 hour with a 0.01 M $CaCl_2$ solution (1:10 soil-solution ratio) which contains 30 mg P L^{-1}. Through their field and greenhouse studies this measure of 'remaining solution P' has been found to be highly correlated with differences in Mehlich-1 critical soil P levels and Mehlich-1 fertilizer P recovery among soils in the region. Equations have been developed such that crop-specific P requirements and fertilizer recommendations are provided based on laboratory measures of existing extractable soil P and 'remaining solution P'.

Roberto Novais is willing to validate performance of their P requirement method on soils from other locations, preferably where experiments to characterize crop P fertilizer responses have already been performed. To perform the necessary lab measurements, Roberto would need about 30g of soil from land that has either received no fertilizer P or a small sub-optimal level of applied P. I can think of at least three experiments within Brazil that would have the necessary soil and crop data for this evaluation: an experiment on the Yellow Latosol at the EMBRAPA station in Manaus, and experiments conducted by Leo Miranda on the Dark Red and Red Yellow Latosols at EMBRAPA's Cerrado Research Center near Brasília.

Collection of Pertinent Data from Literature

Soil Science faculty involved with fertility and plant nutrition have 5-6 graduate students who are compiling published data on soil nutrient diagnosis and fertilizer recommendations as their dissertation research topics. Each student is assigned a different crop or commodity, such as corn, tomato, pastures, coffee, etc. Future students will then use the compiled data to develop software for commodity-specific soil nutrient diagnosis and fertilizer recommendations. This concerted effort began during the past year. I was able to help Mr. Carvalho, who is working on corn, by giving him a detailed list of the publications related to the SM-CRSP's prior investigations on acidity, N and P in soils of the Cerrados and Amazon. IntDSS project spreadsheets for compilation of data on lime and fertilizer N field trials were left with Roberto Novais. He agreed to instruct students on the spreadsheets and will eventually share with us data which they collect from various sources within Brazil which are not accessible to us via U.S. libraries.

Visit to CENIBRA

I had the opportunity to accompany Roberto on a visit to CENIBRA's cellulose production facility, an adjoining nursery and tree plantations near Santa Barbara, Minas Gerais. This company produces about 1 million tons of cellulose/year from harvests of approximately 20 million eucalyptus trees/year. At the nursery we observed a hydroponics-sand culture they are developing for production of seedlings from vegetative propagation. Their hope is to improve

seedling quality and vigor over current vegetative propagation in media used for direct transplanting in the field.

Phosphorus is a major nutrient input at seedling planting. Early plant growth response to P is illustrated in Figure 1. Trees are routinely harvested after 7 years.

Figure 1. Comparison of growth at 6 months between eucalyptus fertilized with P at planting (left) and the control without applied P (right).

Roberto and other UFV faculty provide technical assistance to CENIBRA and other cellulose production companies throughout Brazil. Assistance involves frequent visits to eucalyptus farms as well as research by graduate students. While at CENIBRA, for example, we reviewed some recent soil data assembled by Fernando Leite as part of his M.Sc. thesis under Roberto's direction. The data provides comparisons of soil chemical properties between numerous tree plantations and adjoining pasture sites, grouped by tree and pasture age since establishment. In many of the paired sites exchangeable bases were higher and acidity was lower in the pastures than tree plantations. This is probably the result of greater nutrient export in tree harvests than in pasture grazing by animals and the fact that some of the tree sites were in their second or third cycle of tree production.

The UFV in conjunction with CENIBRA and other cellulose production companies have a wealth of excellent data on eucalyptus nutrient requirements, uptake, and soil management for a variety of locations and production cycles. This would be an excellent candidate crop for evaluation of the nutrient diagnosis and prediction approaches which Russ Yost and Adrian Ares are developing for tree systems.

Cerrados Research Center - EMBRAPA/CPAC

It was great to return to CPAC after almost a decade and become re-acquainted with numerous friends. Our meetings began with my slide presentation on the IntDSS project and the software to 8-10 members the soil fertility and plant nutrition group. Thereafter, most of the questions and discussion focused on issues related to EMBRAPA's access to the software, possibilities for customizing the software to fit the particular diagnosis and recommendation approaches used in the Cerrados, consideration of differences among tillage systems, and reasons for focusing software development on acidity, N and P at the expense of K and micronutrients. Most of my answers essentially came back to funding limitations and access to information and knowledge needed to make a DSS that was globally relevant. I re-iterated that their collaboration in the project was important both from the standpoint of gaining access to prior research data, transferable to other regions with similar ecosystems, and in validating performance and defining future refinements needed for the software. I indicated the project's willingness to work with them in streamlining the software to Cerrados conditions, provided they took the lead in developing the required algorithms and contributed to the development of the necessary revisions in program code.

With the teams agreement to collaborate with the project, Drs. Leo Miranda, Claudio Sanzonowicz and I then met with the CPAC directors, Dr. Carlos Magno and Mr. Eduardo Assad. One of the directors' primary concerns was funding (estimated at \$500 month^{-1}) to support office personnel who would be required to compile files of pertinent data from previous investigations. I indicated that our budget would not allow us to commit to anything else but international travel support for CPAC representation at software evaluation workshops. Nevertheless, the project would be willing to assist them in leveraging funds from any potential donors that they might identify. The United Nations Development Program, known as PENUD in Brazil, was mentioned as one possible alternative.

The remainder of my visit at CPAC focused on bringing Leo and Claudio up to speed on project developments, demonstrating the IntDSS software, and discussing potential modifications. Their initial reaction was that the software asks too many questions and details. From their perspective in a mechanized and fertilized agricultural system the questions on economics could be simplified to cost of inputs, outputs and the combined cost of transportation and lime/fertilizer incorporation

On the software questions on lime quality, they suggested two options: (a) a question about $CaCO_3$ equivalence and, if not available to the user, (b) the existing question about lime particle size and analysis to calculate the equivalence. As with many other research centers in Brazil, their lime recommendations are now based on % base saturation of cation exchange capacity (CEC) measured at pH 7. They believe this procedure works better on the sandy soils (Quartzipsamments) and Humic Gley soils than liming based on % Al saturation of the effective CEC. They also felt that critical soil P levels by IntDSS for soybean on Oxisols with 45 and 60 % clay were too low.

USAID - Brasília

I briefly met with Dr. Eric Stoner at the U.S. Embassy. The primary focus of the Mission is towards fire prevention and mitigation of deforestation in the Amazon. Some support is also provided towards rainforest preservation in the Atlantic Coast region. Although the Mission has

no funds to assist Brazilian institutions willing to collaborate with our project, Eric expressed interest in our goals and objectives, and would like to be informed of future developments. He also provided me with contacts for a foundation which might provide international travel support for Brazilian scientists to attend our software evaluation meetings.

South Africa:

Travel to the Cedara Agricultural Development Institute near Pietermaritzburg in KwaZulu-Natal was the outcome of a visit to N.C. State Univ. by Dr. Neil Miles in 1997. At that time, Neil described research results and future development plans that were very similar to those of our project. A stop in South Africa during programed travels from Brazil to Philippines was a cost-effective opportunity to reciprocate to Neil's visit and meet with Cedara staff to explore potential collaborative activities.

Meetings and discussions with the Cedara staff began with my slide presentation on the IntDSS project followed with presentations by Guy Thibauld, Vladko Kitusic, Victor Roberts, and Alan Manson describing the primary activities in soil fertility and plant nutrition which are being conducted at the Cedara Institute. Hopefully, it will be apparent in the following that IntDSS and Cedara Institute share a lot of common ground in their approaches to soil nutrient management.

Predominant cropping soils are Ultisols, Alfisols and Oxisols. Selected properties are shown in Table 1 for Plinthic Paleudults and Typic Haplorthoxs wherein Farina and Channon (1991) reported on lime requirement studies for corn. In their study of soil P sorption, Bainbridge and co-workers (1995) investigated 50 soils in the KwaZulu-Natal region. Ranges in selected surface soil properties were 4 - 73% clay, 0.2 - 9.2% C, pH in water of 4.2 - 8.3, 168 - 10,133 mg L^{-1} oxalate-extractable Al, and 5 - 1,174 mg P kg^{-1} soil to obtain 0.2 mg L^{-1} of P in solution. Major crops grown in the region, and investigated by Cedara Institute programs, include corn, soybean, potato, and pastures. The Cedara Institute soil and plant analysis interpretation manual (Manson et al., 1999) also contains data for wheat, cotton, peanut, sunflower, sugarcane, and various vegetables, fruits and nuts.

Soil acidity diagnosis and lime recommendations are based on N KCl-extractable Al+H saturation of the effective CEC. As with IntDSS lime is recommended in amounts to reduce acid saturation % to a crop critical value (20% for corn and soybean, for example). However, the factor for estimating the lime needed to neutralize 1 cmol L^{-1} of exchangeable soil acidity varies with the targeted crop critical acid saturation value. It is believed that proportionately more lime is needed to neutralize a unit of acidity at low levels of acid saturation (i.e. less than 20%) relative to a unit of acidity at high levels of acid saturation. Thus, the lime requirement (using pure $CaCO_3$ for simplicity) is as follows:

$$\text{Lime req (t ha}^{-1}) = [\text{Exch. Acidity} - (\text{Eff. CEC} * \text{TAS}/100)] * F$$

where:

TAS = crop critical acid saturation %; and

F = lime neutralization factor.

For TAS $\geq$20%, F = 4. For TAS <20%, the F value changes with TAS by the following expression:

$$F = 5 - [(\text{TAS}/100) * 4]$$

Thus, the lime neutralization factor can vary from 4 to 5 within the acid saturation range of 20 to 0%.

Table 1. Selected surface layer properties for an Ultisol and Oxisol in KwaZulu-Natal, South Africa. Source: Farina and Channon (1991)

PROPERTY	AVALON SANDY LOAM PLINTIC PALEUDULT	BALMORAL CLAY TYPIC HAPLORTHOX
Organic C, g kg^{-1}	4	35
Clay, g kg^{-1}	100	760
Silt, g kg^{-1}	50	100
Exch. Ca, cmol L^{-1}	0.56	1.19
Exch. Mg, cmol L^{-1}	0.35	0.30
Exch. K, cmol L^{-1}	0.21	0.27
Exch. Al + H, cmol L^{-1}	0.25	3.25
Effective CEC, cmol L^{-1}	1.37	5.01
pH in KCl	3.9	3.9

Crop critical acid saturation % is the same for both corn and soybean (20%), but field and laboratory results indicate that soybean provides a greater proportion of maximum yield at higher acid saturation values than does corn (Cedara Institute, 1993). Thus, the shape of soybean and corn yield response curves across acid saturation values greater than 20% would be different. This is in contrast to data in other regions and currently used by IntDSS, wherein soybean and corn yield response curves to acid saturation % are similar. One possible speculation is that greater N and K inputs on corn in South Africa might provide sufficient salt effect to displace more Al into soil solution than with lower fertilizer inputs (zero N) on soybean (E.J. Kamprath, personal communication). Lime by P interactions on crop yield are frequently interpreted as a liming effect by P. There are significant and frequent yield response by soybean to applications of Mo.

Two strategies are used to alleviate subsoil acidity constraints: deep lime incorporation with specialized “ripper” equipment and surface applications of gypsum at rates of 4+ t ha^{-1} (Farina et al., 1993). In contrast to our experiences with Oxisols in the Brazilian Cerrados and Amazon, movement of lime-derived Ca and Mg has a negligible effect on alleviating acid constraints to crop root growth in the subsoil. Recommended rates of surface applied gypsum also are greater than those used in the Cerrados. Farina (1997) attributes this difference to (a) greater reserves of soil acidity and (b) less prevalence of Ca deficiency in subsoils of KwaZulu-Natal.

Nitrogen recommendations are similar to those used by IntDSS - dependent of targeted crop yields. Fertilizer N recommendations for corn range from about 120 to 160 kg N ha^{-1}, based on

experiments encompassing 34 crops at five sites. Optimum corn yields are in the order of 7 - 8 t ha^{-1}.

Phosphorus diagnosis and recommendations are based on soil P extracted with the Ambic solution, which is a modification of the Olsen extractant. The Ambic solution is adjusted to pH 8.0 and contains 0.25 mol L^{-1} NH_4HCO_3, 0.01 mol L^{-1} NH_4F, and 0.05 g L^{-1} Superfloc N100 (Farina et al., 1993). Fertilizer P recommendations are based on the following expression (Manson et al., 1999):

$$\text{P Rec. (kg ha}^{-1}\text{)} = (\text{TAP} - \text{AP}) * \text{PRF}$$

where:
TAP = Ambic soil P critical level for the targeted crop,
AP = current soil Ambic-extractable P level, and
PRF = soil P requirement factor, i.e. the amount of P in kg ha^{-1} required to raise soil Ambic P by 1 mg L^{-1}.

As with IntDSS both TAP and PRF values are dependent on soil clay content, but the effect of soil texture is conveniently predicted in KwaZulu-Natal by soil sample density, i.e. g of soil per ml. Sample density is quickly determined in the lab by a non-destructive scan by near infrared spectrophotometry (NIRS) on equipment designed for analysis of animal feeds. In fact, this single NIRS scan has been calibrated to estimate both sample density and organic C. Upon describing the problems we have in IntDSS to predict TAP and PRF in soils with and without gibbsite, Alan Manson indicated that the same NIRS scan also provides a shoulder or peak that was a qualitative indication of gibbsite in samples. The same NIRS equipment has also been calibrated for estimating N content of selected plant tissues.

Although Ambic soil P levels are often reduced with liming, crop yields and P uptake seldom reflect the observed decline in soil extractable P (Cedara Institute, 1993). Vladko Katusic's work with P fertilization of potatoes in various soils (Katusic et al., 1998) shows similar responses to fresh vs. residual P as that observed by Espinosa in Andisols of Ecuador; at the same level of soil test P, potato yields are higher with freshly applied P than with residual P.

The Cedara Institute staff was very supportive of developing collaborative activities with the IntDSS project. Upon release of the first prototype, they will evaluate the IntDSS software by comparing diagnosis and recommendations with those established by numerous field trials with lime, N and P on various soils, primarily cropped to corn and soybean. There are several areas of knowledge synthesis in IntDSS which could be improved by incorporation of data developed in KwaZulu-Natal:

- Vladko's work comparing Ambic extractable P with other solutions (Bray-2, Olsen, Truog and various anion exchange resins) serve as a starting point in developing conversion factors between the Ambic or other conventional extractant methods.
- how will the IntDSS PRF and critical P level relations with clay content fit the data for soils in KwaZulu-Natal? The same question could be made about estimates of residual fertilizer P effects.
- how do IntDSS lime predictions compare to those by the Cedara Institute model? Would application of the variable lime neutralization factor improve predictions for existing lime data sets in IntDSS?

- the corn N fertilization data sets from Cedara should be compared to and grouped as need with the data sets thus far analyzed for South America. The Cedara Institute staff had an interesting suggestion on the South American corn data that merits further investigation. Upon seeing the large scatter in the relations between apparent N recovery and applied N, they suggested including a co-variable for native soil N supply. The rationale is that differences in soil N supply impact this relation by changing the yield response slope (and thus N recovery) between subsequent fertilizer N rates.
- their long term studies provides good evidence and numbers on acidification of the soil profile during long-term cultivation. These data may be helpful in developing predictions on soil acidification and residual lime effects.

Alan Manson agreed to serve as the primary contact for future correspondence on collaborative activities with the Cedara Institute staff. I am very grateful for Neil and Alan's preparations for a productive visit and the Cedara staff's willingness to take time from their busy schedules to share information and ideas during our meetings.

Philippines:

USAID - Manila

Upon arriving in Manila after 17 hours of flying time from Johannesburg, I went directly to the USAID offices to meet with Dr. Michael Yates and Ms. Lina Jensen. They were very understanding about my jet-lag-induced incoherence. The focus of the meeting was to inform the office about the nature of our project's activities in the Philippines during the last two years and our plans for the coming year. Mike requested that we keep the Mission informed of project activities. This should include advanced notification on travel from the U.S. as well as trip reports for each travel event. Ms. Jensen has tried several times, with no success, to contact Dr. Teodula Corton via calls to PhilRice at Maligaya. She would like to learn further details about PhilRice's role as the national institute collaborating with our project. I forwarded this message to Teodula upon arriving in Maligaya, and she agreed to contact Ms. Jensen upon returning from her trip to Hawaii.

The Mission would also like to be appraised on our plans for the workshop, once it is fully developed. Mike indicated that personnel connected with one of their development projects in Mindinao might benefit from attending this meeting.

Philippines Rice Res. Inst. (PhilRice)

The USAID meeting was followed by a 6-hour drive to PhilRice headquarters at Maligaya and a very welcome bed in the dormitory. The following day I met with Drs. Corton, Leocadio Sebastian and Mr. H.C. Gines. I was presented a video about PhilRice, we discussed existing plans for the workshop and toured building, housing and field facilities. They have state-of-the-art facilities. There are auditoriums and several large meeting rooms with projectors for computers, slides and overheads (Figure 2). Dormitories and eating facilities are nearby. Rooms can accommodate from 1 to 4 occupants and should be available during the targeted period for the workshop (Figure 3).

PhilRice is very willing to contribute to successful implementation of the workshop through access to their facilities during the period of August 2-6. Deanna Osmond (NCSU) and Teodula have and will be in continued contact to develop workshop plans. However, there were several logistical matters which we discussed that have bearing on future development of plans:

Figure 2. Example of one of the meeting facilities at PhilRice headquarters in Maligaya.

Figure 3. Dormitory and cafeteria facilities at PhilRice Headquarters

- *arrival/departure in Manila* - one day needs to be allocated for arrival to and for departure from Manila by international participants; in both cases participants should be housed in a hotel near the Manila airport;
- *visas for Philippines* - not all countries have a Philippines embassy and this might complicate obtaining travel documents for some workshop participants; PhilRice is willing to work with the Ministry of Foreign Relations to send participants in such countries a letter which will facilitate their travel arrangements;
- *field visit to Ilagan/return to Manila* - upon completion of the workshop at Maligaya, a field visit is scheduled for the project's site near Ilagan; this is an additional 6 hour drive North from Maligaya; the option of airline travel from the Ilagan region back to Manila no longer exists; thus we will have about a 12-hour bus ride back to Manila.

Upon subsequent reflection and discussions with Dr. Thomas George, while at IRRI, it occurred to me that some of the international participants will gain their first exposure to paddy rice systems during their visit to the Philippines. The video which I was presented on PhilRice and a tour with pertinent demos in the adjoining field research facilities would be a valuable education on paddy rice systems for some of the participants. Perhaps this could be scheduled for the afternoon of August 2 after participants arrive in Maligaya from Manila. Food for thought by Deanna and Teodula.

Project Field Site near Ilagan

Thomas George drove over from IRRI to join Ms. Josephine Lasquite and me in our 5-hour drive to Ilagan. Teodula could not join us because she was preparing for imminent travel to Hawaii for a meeting with Yost and Hue to assess current results and plan project activities for the coming cropping season.

The core experiment at Barangay San Antonio was in the pod filling stage of the peanut crop. Treatments and early peanut growth are described in Hue's recent trip report (see the file marked "Philippines, January 17-23, 1999" at the project's web site: *http://intdss.soil.ncsu.edu/sm-crsp/Download/Download.htm#Trip Reports*). Symptoms of Mn toxicity at early growth stages (suspected during Hue's visit and confirmed by Teodula through subsequent leaf analysis) were no longer evident. Peanuts were irrigated during at least two dry spells to avoid losing the crop. The most noticeable difference among treatments for the replicate downhill from the hospital was the growth response between the control treatment (no lime and P inputs) and the other treatments (Figure 4). In the replicate uphill from the hospital we also observed that the treatment with lime but no P was similar to the control treatment (Figure 5). This suggests that the native soil available P level in this replicate is lower than in the replicate downhill from the hospital. Non-nodulating soybean plots are included in each replicate to estimate N supplied from native soil reserves (Figure 6). Thomas estimates that N uptake by these soybean plots will be in the order of 20 - 30 kg ha^{-1}. Planned measurements at harvest, such as shelling %, may help clarify the nature of the crop's yield response to lime, gypsum and P.

The extent of the dry spells was evident in a trial to evaluate IntDSS recommendations in a farmer's field adjacent to the core experiment. Corn plant stand was irregular and had a low population. There were no discernible differences between the plots with IntDSS-recommended inputs or farmer practices.

Figure 4. Peanut growth in the control plot (no lime or P added) relative to other treatments with lime and/or P in the core experiment replicate that is downhill from the Brgy. San Antonio hospital.

Figure 5. Comparison of peanut growth between the control plot with no lime or P (left) and the P0 treatment with only lime (right) in the core experiment replicate that is uphill from the hospital.

Figure 6. Plot with non-nodulating soybean in the core experiment replicate that is uphill from the Brgy. San Antonio hospital.

The next morning we had several meetings at the Ilagan Experiment Station before starting the 12+ hour trip back to Los Baños. Discussions focused on possibilities to include plots to test lime, N and P recommendations by IntDSS into the on-farm demonstration plots which the Ilagan Station plans to install during the coming planting season. Mr. Tumamao, the Station Director, was receptive to this plan and requested that Thomas prepare a description of the demonstration protocols. This was then discussed in greater detail with Josephine and the Ilagan Station specialists for rice, corn and soybean. Thomas indicated that the project would like to implement these demos at about 15 different sites. Soil samples need to be collected and analyzed; results will then be run through IntDSS to perform a diagnosis for acidity, N and P constraints for the targeted crops; if a nutrient constraint is predicted then the lime, N and P inputs recommended by IntDSS will be applied to the demo plots and compared with farmer practices and other plots containing the recommendations of the Ilagan Station.

Thomas made it clear that the selected sites do not have to be both acidic and N or P deficient. This criteria enables consideration of demonstration plots on farms throughout the region of Ilagan Station operation and beyond the Barangay San Antonio.

Int. Rice Res. Inst. (IRRI)

While at IRRI, I had short visits with Drs. Kirk and Manoharan followed by a meeting with Dr. Ron Cantrell wherein I described our project activities and plans under development for a workshop at PhilRice. Ron was supportive and interested in the project and the workshop. I agreed to inform him about the workshop in greater detail, once the plans were fully developed.

I provided Thomas with a complete copy of all project documents and trip reports that are posted on the web site. We also discussed various aspects of the potential workshop schedule and pending activities for the core experiment and on-farm demonstrations at Ilagan. Two major points came out of these discussions:

- Based on our experiences during this trip to and from Ilagan, we believe that the original workshop schedule should be expanded by one day to ensure adequate transportation between Manila, Maligaya, Ilagan and the return to Manila. This would expand the workshop period in Maligaya from Monday, August 2 to Thursday, August 5. Friday, August 6 would be devoted to a tour of Barangay San Antonio, near Ilagan and the return to Manila.
- The N module is not yet operational in the "pre-release" of the first IntDSS software prototype. Therefore Thomas needs help from the project's N group to produce IntDSS diagnosis and recommendations on N for the on-farm demonstration plots. I agreed to convey this message to Shaw Reid in the hopes that he can work with Thomas in developing a rule set and database values for upland rice, corn and soybean. Planting season begins in May, and the recommendations should be in the hands of Ilagan Station trial supervisors before planting.

List of Contacts:

Brazil

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Dr. Orlando da Silva, Economics
Dr. Roberto Novais, Soil Fertility and Plant Nutrition
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Ms. Ecila Villani, Soil Science Graduate Student
Mr. Fabio Torres de Carvalho, Soil Science Graduate Student

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Mr. Antonio Fabris, Soil Scientist
Mr. Fernando Leite, Soil Scientist
Mr. Deuselis Firme, Forester

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Mr. Eduardo Assad, Assist. Director
Mr. José Neto, Foreign Relations Coordinator
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USAID - Brasília

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Dr. Robin Bennet, Plant Physiology
Mr. Vladko Kitusic, Soil Fertility and Plant Nutrition, Potatoes
Mr. Guy Thibauld, Soil Fertility and Plant Nutrition, Lime and P
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Pertinent Literature:

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