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ANNUAL REPORT
211(d) BASIC GRANT
(AID/csd - 2833)

MICROBIOLOGY AND MINERALOGY OF TROPICAL SOILS

UNIVERSITY OF HAWAII
COLLEGE OF TROPICAL AGRICULTURE
DEPARTMENT OF AGRONOMY AND SOIL SCIENCE
HONOLULU, HAWAII

FOR THE PERIOD COVERING
JULY 1, 1977 to JUNE 30, 1978

SUMMARY PAGE

211(d) Annual Report
Date due: August 30, 1978
Date: September 1, 1978

Grant Title: Microbiology and Mineralogy of Tropical Soils

Grantee: The University of Hawaii

Grant Program Director: Goro Uehara

AID Sponsoring Office: Development Support Bureau/AGR

Period of Grant: July 1, 1976 to June 30, 1979

Amount of Grant: $500,000

Expenditure for Report Year: $191,571

Accumulated: $263,234

Anticipated for Next Year: $236,760

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I. Narrative Summary

Grant objectives were 50-80 percent completed at the end of the reporting year. The grant period was extended 12 months without additional funding to enable faculty to complete seven state-of-the-art reports on soil microbiology and mineralogy.

By the end of the second reporting year, 60 percent of the allotted budget was expended. No change in grant purpose or objectives was required, and all critical assumptions were met.

Lack of a standard soil science language for effective technology transfer in the tropics has been identified by the Consortium on Soils of the Tropics as a key constraint to country development. In close cooperation with and support from the AID sponsoring office, the Consortium has developed a strategy to correct this deficiency. The Consortium universities have selected Soil Taxonomy, a soil classification system developed by the U.S. Department of Agriculture, as the standard language to communicate soil information. This strategy was first tested in Latin America in the past year, and the successes there have enabled the Consortium to plan a similar effort for Southeast Asia this year. For the first time, there appears to be emerging an acceptable, international language for organizing knowledge for technology transfer in the tropics.

There is now hope that the information contained in the state-of-the-art reports may be disseminated by means of Soil Taxonomy. The University of Hawaii is responsible for preparing seven state-of-the-art reports. Progress on them is provided in this annual report.

II. General Background and Description of the Problem

Between June 1970 and March 1971, five institutional development grants were awarded to U.S. universities through the Institutional Grant Program established by Section 211(d) of the Foreign Assistance Act of 1961 as amended in 1966. The grants were made to enhance the existing competence in tropical soil science of the recipient universities. The recipients were Cornell University, the University of Hawaii, North Carolina State University, Prairie View A & M University and the University of Puerto Rico.

Since 1970, these universities have worked together to develop training, research and advisory capacity related to application of soil science to the tropics. As a means to coordinate their efforts, these institutions grouped themselves into a "Consortium on Soils of the Tropics." In 1967, the University of Minnesota was admitted to the Consortium as a non-funded member.

If the grant purpose was to enlarge university competence in tropical soil science, the goal was to improve the quality of life of the small farmer by enabling him to overcome soil barriers which stood in the way of profitable farming. One thing was certain--efficient and profitable farming, particularly on small farmer fields, deteriorated with increasing proximity to the tropics and the equator. History and experience told us that the rich entrepreneur (plantation farmer) could make infertile lands productive and the poor farmer could do well on fertile soil, but the poor farmer on infertile soil could not extricate himself from poverty's grip. There are today about two billion people who live in countries with average gross national products of about $200 per capita. Virtually all of these countries occur in and near the tropics.

The unbearable poverty of the small farmer stems from the impoverished state of his soil. The impoverished state of tropical soils is in turn related to their high degree of weathering. Soil minerals which normally hold nutrients against leaching have been weathered out, and the remaining insoluble residues do not have the capacity to hold life-sustaining nutrients. A large part of current knowledge and ongoing research does not apply to highly weathered soils, so that technology from the technically advanced countries of the temperate regions, when transferred to the tropics, predictably fails.

Highly weathered soils are not only deficient in nutrients, they are frequently acid and contain toxic levels of aluminum and manganese. They "fix" and render unavailable to crops large quantities of phosphorus fertilizer. Without phosphorus and in the presence of toxic elements, the conversion of atmospheric nitrogen into protein through symbiotic association of bacteria and plant cannot proceed. Thus high yielding varieties bred to respond to fertilizers do not do well in extensive areas of the tropics where soil and people are impoverished.

A strong program, a long history of research and development in tropical soil science and an expression of commitment to international programs by University of Hawaii officials were the principal reason for awarding this grant to this institution.

III. Program Goals and Grant Purposes

The program goals to which this grant contributes are:

1. To increase the quantity and to improve the quality of food for the small farmer in the tropics, and

2. To enable developing nations to make better use of soil, water and crop resources for national development.

The grant purposes contributes to the attainment of program goals by:

1. Utilizing grantee competence in tropical soil management and developing new competence in soil microbiology, especially for biological nitrogen fixation, and

2. Determining ways to overcome key constraints (especially of phosphorus unavailability and nitrogen deficiency) on food production.

IV. Grant Products

The grant products are tangible evidences of attainment of grant purposes. The products have immediate and long term value for development and are especially tailored for developing country use. The grant products are:

A. An expanded knowledge base in microbiology and mineralogy of tropical soils. Seven state-of-the-art reports will be the final grant products.

B. An information capacity for agroproduction technology transfer consisting of a computerized information retrieval system and a soil data bank.

C. An education and training capacity consisting of an audio-tutorial package in soil science designed for testing and adoption in the Philippines.

D. An advisory capacity for development support consisting of faculty from the grantee institution.

E. Linkages with a network of international and national development support organization to facilitate utilization of institutional response capability.

V. Review of Critical Assumptions

A table summarizing program goals and ~~project purposes~~, outputs and inputs together with corresponding critical assumptions is provided on the next page. To date, all critical assumptions have been realized.

VI. Accomplishments

This section is organized according to grant products. A summary outline which identifies products and scientists in charge is given below. Following the outline, accomplishments are presented in narrative and tabular form

Outline of Products

A. Expanded Knowledge Base

1. State-of-the-art (SOTA) report on phosphorus unavailability in tropical soils (R. L. Fox)

2. SOTA reports on biological nitrogen fixation in tropical pasture legumes and grasses

   SOTA on the plant as a limiting factor (P. P. Rotar)

3. SOTAs on microbiology as a limiting factor

   a. Biological nitrogen fixation in grasses (B. Bohlool)

   b. Mycorrhizal associations (B. Bohlool and B. Mosse)

4. SOTAs on the soil as a limiting factor

   a. Soil-related stresses (Y. Kanehiro)

   b. Allelopathy (D. Bartholomew)

   c. Soil erosion (S. A. El-Swaify)

Table 1. Summary of assumptions for achieving goals, purpose, outputs and inputs.

Program or sector goal: The broader objectives to which this project contributes: To increase quantity and improve quality of food for the small farmer. Subprogram goal: To enable LDCs to make best use of soil, water and crop resources.	Assumptions for achieving goals: LDCs will give high priority and support to improved agricultural production by small farmers.
Project purpose: 1. Utilization of competence in tropical soil management and development of competence in soil microbiology, especially biological nitrogen fixation (BNF). 2. Determination of ways to overcome key constraints (especially P and N) on food production.	Assumptions for achieving purpose: 1. LDCs desire to use better soil management will collaborate and use better management systems. 2. Staff at U.H. are willing to obtain useable information about soil management and BNF; AID, LDCs and other will use expertise. 3. Leadership and services of value will be scientifically and practically provided by U.H.
Outputs: 1. Expanded knowledge about (a) P unavailability in tropical soils and (b) BNF, especially in forage crops, and effects on soil management systems. 2. Information capacity on tropical soil microbiology and mineralogy. 3. Development of soils teaching training package for use in developing countries. 4. Advisory capacity. 5. Increased linkages and networks with scientists in soil management and BNF in LDCs.	Assumptions for achieving outputs: 1. LDC, international scientists, AID will cooperate in preparation and use of SOTAs. 2. Information is desired in LDCs. 3. Need is for teaching materials; equipment available. 4. Advisory capacity will be used by LDCs, AID/U, USAID under mutually satisfactory arrangements. 5. U.H., COST will continue international commitment.

Inputs:	Assumptions for providing inputs:
U. Hawaii	
1. Experts in Soil Management (SM) and BNF - senior and junior staff.	1. Qualified experts will remain on staff or replacements promptly found.
2. Junior scientists and graduate students, support staff.	2. LDC scientists, decision-making personnel and students willing and able to participate.
3. Field, laboratory, computer, teaching, library, office, administrative, accounting facilities.	3. U. Hawaii facilities will be available and support continued.
COST *	
4. Staff to cooperate on SOTAs SM studies.	4. COST scientists willing to cooperate.
AID	
5. Financial support.	5. AID funding, management aid and involvement provided.
6. Project management (TA/AGR) involvement.	

* COST = Consortium on Soils of the Tropics

B. Information Capacity

1. Retrieval System (P. Rotar)

2. Soil Data Bank (H. Ikawa)

C. Education and Training Capacity (R. Green)

D. Advisory Capacity (Chairman of Department, Grant Project Director)

E. Linkages and Networks (Grant Project Director)

Narrative Summary of Accomplishments

A. Expanded Knowledge Base

1. Phosphorus unavailability in tropical soils (lead scientist: R. L. Fox)

Accomplishments of the past year include inputs of data and information as well as outputs of information through preparation and publication of manuscripts, participation in symposia, etc. These activities will be arbitrarily divided into inputs and outputs.

a. Inputs

Efforts at expanding the knowledge base proceeded in two directions: a) Confirmation of existing reports on phosphorus management in tropical soils through data collected locally and that provided by cooperating researchers in other areas of the tropics; and b) Collection of information through participation in symposia, mail contact with active researchers and scientists, travel to geographic areas, and preparation of questionnaires.

1) Requests for experimental data and cooperative work were continued from the previous year. Yield data from field experiments are collected and soil samples from the check plots are sent to the University of Hawaii for P analysis. The yield data are then related to the soil analysis

data and the results compared for various locations for this crop. Such data were obtained from the following studies or experiments.

a) Soil management transfer experiment. Data from Peru were received for a P response experiment with potatoes. These data were compared with data from Bangladesh, Alaska, Canada, and Hawaii. The data pointed to a similar P requirement as measured by sorption curves. Two manuscripts have been prepared from these studies.

b) Data from root crop research were obtained from local experiments on cassava, yam, and taro. Data were also obtained from cooperators in Thailand, Malaysia, Colombia, and Nigeria. These data form part of the thesis research of a graduate assistant, P. Vander Zaag.

c) The above approach is being extended to the cereals wheat and rice. Data were obtained from a wheat study in India which suggested an external P requirement of 0.2 μg P/ml, using the sorption curve technique. Other data are being collected from Pakistan and Nebraska in order to compare P requirements of wheat among temperate and tropical regions. Other scientists have been identified for further contact and data. These data will be compared in order to obtain several independent estimates of external P requirements for cereals.

Cooperative work was initiated with IRRI, Los Banos, Philippines, whereby yield data and soil samples from a multinational study on application of phosphate to flooded rice are being made available for our evaluation. Soil samples from rice experiments have also been obtained from Taiwan.

d) An experiment was conducted to study the contribution of mycorrhiza to the phosphorus nutrition of several crops on a P-deficient soil (Eutrustox) in Hawaii. This experiment was the first study of mycorrhiza

in the State and served to generate interest as well as new data on this important aspect of P nutrition of crop plants. Numerous scientists visited the plots, including a group of conferring scientists from the 2nd review meeting of the INPUTS project of the East West Center. This provided an initial exposure to the importance of mycorrhiza for 60 scientists from 15 tropical countries.

An important contribution to the mycorrhiza study was provided by Dr. Barbara Mosse, who has prepared a SOTA on mycorrhiza as a part of the SOTA on biological nitrogen fixation (lead scientist: Ben Bohlool). Skills learned in a short course provided by Dr. Mosse were applied in collecting data from the experiment.

The results of this experiment point out the major role of mycorrhiza in P nutrition of crops when under P stress. In some cases, over 10 times as much P was absorbed by plants on plots which were not fumigated (mycorrhizal) than on plots which were fumigated (non mycorrhizal) at a given level of P. (Root measurements confirmed the presence of mycorrhiza with no fumigation and their absence as a result of fumigation). One important conclusion from the study was that while mycorrhiza contributed greatly to P absorption under conditions of P stress, the contribution was minimal when sufficient P was applied to obtain 90-95% of maximum yield. It was also apparent from this study that many implications of mycorrhiza to P phosphorus management in the tropics remain to be determined.

e) An investigation on influence of localized P placement on the efficiency of P utilization was continued by a graduate student, Kazi Memon. These studies indicate that, with corn, near maximum yield could be obtained by P application to less than the entire rooting volume. Similar

results were obtained with soybean on the same Wahiawa soil (Eustrustox). This soil has a high phosphorus buffering capacity. Both of these placement studies indicated that advantages continued into the second planting of the experiments. In contrast, little or no advantage was obtained to placement in a restricted soil volume in a field study earlier conducted by R. L. Fox and B. T. Kang (see publication list). Reasons for this contrast are under study.

f) Phosphorus atlas. Additional soil samples have been collected from Southeast Asia and Australia. Phosphorus sorption curves have been completed on these soils, and the results will be assembled in tables and maps based on soil survey information as well as by transects across gradients of rainfall and/or elevation. A comparision of approaches is planned. The Benchmark Soil Project has assisted in the soil acquisition phase of this work.

g) A questionnaire was prepared and distributed to provide factual information on current methodologies of diagnosis of need and recommendation of phosphorus fertilizer for crops. Information was requested on soil analysis methods, critical ranges, disadvantages and successes of the current practices.

h) Numerous contacts have been made during the year in addition to those mentioned above. Continuous cooperative efforts toward the sharing of results have been established with the Institut Mondiale du Phosphat in France. A series of soil samples from field experiments in Jamaica are expected. Results from several hundred fertilizer trials in Central America are to be analyzed in cooperation with J. L. Walker.

B. Outputs

1. Symposia attended and manuscripts prepared:

a. Soil Science Society of America, National Meetings, Symposium on Soils of the Tropics. Prepared the manuscript "Phosphorus adsorption by soils of the tropics R. L. Fox and P. L. E. Searle.

b. CSIRO Symposium on Nutrition of Legumes, Cunningham Laboratory, Brisbane, Queensland, Australia. Prepared the manuscript "Studies on P nutrition in the tropics", R. L. Fox.

c. Symposium on Benchmark Soils in Western Africa, University of Reading, England. Manuscript titled "Some aspects of soil fertility management problems of Alfisols in western Nigeria", B. T. Kang and R. L. Fox.

d. International Soil Science Society, Edmonton, Alberta, Canada. Prepared the manuscript "The utility of P adsorption curves for predicting P requirements for potato." P. Vander Zaag et al.

2. Other manuscripts prepared:

a. "The utility of P adsorption curves for transferring soil management information." P. Vander Zaag et al. Submitted to Tropical Agriculture (Trinidad).

b. Phosphorus fertilizer requirements as estimated by P sorption D. E. Peaslee and R. L. Fox, accepted by Communications in Soil Science and Plant Analysis.

c. "Phosphorus nutrition of plants influenced by Mn and Al uptake from an Oxisol." J. P. Jones and R. L. Fox, accepted by Soil Science.

d. "Influence of residual P fertilizer on labile and extractable Zn in Hawaii soils." M. Saeed and R. L. Fox, accepted by Communications in Soil Science and Plant Analysis.

3. Manuscripts published:

a. "Influence of P fertilizer placement and fertilization rate on maize nutrition." R. L. Fox and B. T. Kang. Soil Science 125:34-40. 1978.

211(d) Institutional Grant
Project Design Summary

Project Title: Mineralogy and Microbiology of Tropical Soils

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	REPORTING YEAR ACHIEVEMENT	FUTURE PLANS, REMARKS
Outputs: R. L. Fox			
Output No. I. Expanded knowledge			
1. State-of-the-art on phosphorus unavailability. Collection, review and analyses of existing experience and knowledge on management of native and added soil phosphorus in food production in tropical developing countries. Develop an authoritative document on P status of, and P reactions in, soils of the tropics.	1. Identify knowledgeable investigators (at least 20 in the tropical zone and 30 in the temperate zone) doing research on the P status of highly weathered soils. Prepare SOTA outline and assign topics.	1. Additional 50-75 investigators identified and contacted. SOTA outline topics assigned and development in progress.	1. Continue information flow with investigators. Completion of SOTA rough draft.
	2. Collect published material from investigator-collaborators and obtain leads on sources of unpublished information which promise to have value (translate if necessary).	2. Approximately 500 reprints collected. A selected bibliography was organized and keywords provided.	2. Complete the reprint file. Improve accessibility through cross-referencing, etc.
	3. Summarize and map information.		3. Prepare tables and/or maps o collected information showin areas of P deficiency and high phosphorus sorption.
	4. Supplement and confirm data using soil samples secured for this purpose	4. Analytical work completed on a large portion of samples received.	4. Do analytical work on samples from additional experiments and survey areas.
	5. Write sections of SOTA for this section.	5. Details of SOTA outline prepared.	5. Complete the preparation of SOTA rough draft.

211(d) Institutional Grant
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Project Title: Mineralogy and Microbiology of Tropical Soils

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	REPORTING YEAR ACHIEVEMENT	FUTURE PLANS, REMARKS
Outputs: R. L. Fox			
Output No. I. Expanded knowledge			
SOTA on P unavailability Generate table on external and internal P requirement of important food crops.	1. Identify locations with valid crop yield data (yield as a function of fertilizer or soil P) with or without associated soils information, collect data, plot yield response vs. P applied and P in plant (if data is available).	1. Locations identified, providing yield data for cassava, rice, and wheat.	1. Locate additional useful sites of good experimentation on P response of these and other food crops.
	2. Secure soil samples from 10-20 locations and analyze soil for P solubility and construct P sorption curves.	2. Samples obtained from relevant foreign and local experiments. Phosphorus sorption curves and extractable P determined.	2. Organize and catalog the data obtained.
	3. Interpret data for external requirement and internal P requirement and place in tabular form.	3. Expanded table on external and internal P requirement of several vegetable crops.	3&4. Summarize data obtained to date, analyze and put into publishable form.
	4. Augment field data for important crops for which data is inadequate. Supplement soil analysis data as needed.	4. Instituted trials of a confirmatory nature on cassava, yam, soybean, and cowpea.	
	5. Write section of SOTA report.	5. Prepared papers on P requirement of several vegetable crops, potatoes, and cassava.	5. Inclusion of portions of these papers into SOTA form.

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NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	REPORTING YEAR ACHIEVEMENT	FUTURE PLANS, REMARKS
Outputs: R. L. Fox			
Output No. I. Expanded knowledge			
SOTA on P unavailability Phosphorus management in the tropics.	1. Identify investigators in the tropical zone and in the temperate zones who are concerned with various aspects of P effectiveness for highly weathered soils. Make a bibliography.	1. Lists of investigators interested in P management initiated. Bibliography referenced both by author and by country.	1. Expand contact with investigators to promote additional transfer of information.
	2. Collect published materials or abstracts on crop response to soil and fertilizers, P changes in soil, P as a function of time under cultivation, effective means of P placement, residual effects of fertilization, utilization of various sources of P, mycorrhizal associations, recycling of plant P, efficient utilization of P in plant residues and animal manures and use of various soil amendments to enhance P effectiveness.	2. Over 500 reprints collected and referred to master bibliographic file.	2. Continue to search out important papers and build up reprint file.
	3. Collect information on farmer practices which may have bearing on efficient utilization of P.	3. Visits completed to countries in Asia, S.E. Asia, Queensland, Australia, Canada, and Africa.	
	4. Prepare SOTA section.	4. Requested P management information as part of questionnaire.	4. Incorporate information gained in travel, from symposia, from questionnaires into suggestions for P management section

b. "Phosphate sorption characteristics of some benchmark soils of West Africa." A. S. R. Juo and R. L. Fox. Soil Science 124:370-376. 1977.

c. "Response of vegetable crops to phosphorus concentrations in soil solution." R. K. Nishimoto, R. L. Fox and P. E. Parvin. Journal of the American Society of Horticultural Science. 102(6):705-709. 1977.

2. Biological Nitrogen Fixation in Tropical Pasture Legumes and Grasses

a. The plant as the limiting factor (lead scientist: P. P. Rotar)

A major constraint affecting the rational exploitation of tropical grasslands is that there is no standard evaluation methodology for new grass or legume accessions. For example, do we pair a standard legume with a new grass and vice versa? When do we subject them to grazing stress? How do we quantify grazing stress?

At least one additional major problem has been identified for each of the tropical forage legume genera we are studying. Stylosanthes species are nearly all susceptible to anthracnose (fungus) and stem borer (insect) damage which is most often so severe that it removes stylo as a utilizable forage. Stylo species are also slow to establish; and they do not compete well with other forage species under good soil fertility conditions. Centrosema species are not able to withstand burning, infertile acid soil conditions or rainfall regimes affording less than 1500 mm rainfall per year. Additionally, centro usually lacks vigor in early growth stages and, thus, is hard to establish. Desmodium species major problems are with adequate seed production. Insects must be involved even though Desmodium is self-pollinating. Other factors affecting seeding are unknown and the quantity of seed production is generally very small (<30 kg/ha).

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NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	REPORTING YEAR ACHIEVEMENT	FUTURE PLANS, REMARKS
Output: P. P. Rotar Output No. I. Expanded Knowledge 2. State-of-the-art on biological nitrogen fixation in forage and pasture legumes and grasses in the tropics. Collection, review and analysis of existing experience and knowledge on tropical forage and pasture legumes and grasses, and their contribution to BNF in tropical developing countries. a. The plant as a limiting factor 1. Identification of tropical forage and pasture legume crops--their distribution, acreage and yield. 2. Identification of seed and inoculant sources--their capabilities.	1. Identify collaborators, prepare SOTA outline, assign tasks. 2. Search and inventory international community for data on tropical forage and pasture legumes.	1. Dr. J. L. Walker was assigned as full-time collaborator. A SOTA outline has been prepared for review. Short-term professionals have been queried regarding potential SOTA input. 2. Regarding the potential problems of Centrosema, Desmodium and Stylosanthes in tropical pasture exploitation, Walker interviewed CIAT scientists in Colombia (Drs. Sanchez, Schultze-Kraft, Hutton, Date, Fenster, Fergusen, Halliday, Leon, Song, Tergas and Spain, the latter at the Eastern Plains Station in Carimagua) as well as Drs. Mott and Kretschmer of Florida, Reid of CSIRO: Couto, Franca-Dantas, Primo, Shock and Moore of Brazil: Engels, Goldbach, Leon, Leiva Canales of Costa Rica: Garcia T. of Cuba Riveros of FAO/Rome: Hernandez of Panama, Keoghan of Antigua, W. Indies, and Burton of the U.S. during AID-sponsored meetings held there. In addition, Mrs. Bird, Ms. Dworak and Mr. Evans have compiled more than 1300 citations resulting from	1. Drafts of portions of the SOT prepared for review, new information will be incorpor ated as collaborators provid it. Final preparation of the SOTA is scheduled to commenc January, 1979. 2. Information from the international community is being summarized and this activity will continue until preparation of the final draft of the SOTA commences.

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NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	REPORTING YEAR ACHIEVEMENT	FUTURE PLANS, REMARKS
		a search of CAIN-AGRICOLA, BIOSIS, and CAB-HERBAGE ABSTRACTS files for the period 1970-1978.	
	3. Identify location with valid information on forage and pasture legumes and locate seed and inoculant sources.	3. Replies from more than 200 questionnaires sent to LDCs have been summarized to ascertain the availability of seed and other information concerning the utilization of Centrosema, Desmodium and Stylosanthes.	3. Information will be summarized in tabular form and on maps for inclusion in the SOTA.
	4. Prepare tables on legumes, distribution, acreage, yield, seed and inoculant sources.	4. Data are being organized and evaluated so that useful tables can be prepared.	4. Data will be incorporated in drafts of SOTA chapters for review

Collaborators have been identified and an cutline on this portion of the 211(d) project has been prepared for department review.

Dr. James L. Walker, Production Agronomist with 14 years experience in LDC agricultural development work with AID and NCSU has been hired to coordinate the preparation of the SOTA report.

Mrs. Barbara Bird, Information Specialist, has completed a review of the literature citations in CAIN-AGRICOLA, BIOSIS and CAB-Herbage Abstracts data banks.

Ms. Susan Dworak and Mr. Dale Evans have prepared keyword sets which have been used by Mrs. Bird and Dr. Walker in the literature review and, additionally, Mrs. Dworak and Mr. Evans have complied reference materials for the SOTA from sources that are not computer retrievable.

Mr. Dale Evans has reviewed and partially summarized the 86 replies to more than 200 workers in fields related to tropical pasture management worldwide.

3. Microbiology as a limiting factor (lead scientist: B. Bohlool)

a. Biological nitrogen fixation in grasses (associative nitrogen fixation)

1) An exhaustive literature survey has been conducted. This has revealed many uncertainties concerning the agronomic significance of associative nitrogen fixation.

2) Several scientists directly involved in research in this area have been consulted:

a) Dr. R. Burris, University of Wisconsion, Madison

b) Dr. R. Smith, University of Florida, Gainesville

c) Dr. S. Schenk, University of Florida, Gainesville

d) Dr. R. Weaver, Texas A & M University, College Station

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NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	REPORTING YEAR ACHIEVEMENT	FUTURE PLANS, REMARKS
Outputs: B. Bohlool Output No. I. Expanded Knowledge 3. Microbiology as a limiting factor a. Nitrogen fixation by pasture grass-bacteria associations. A field survey of nitrogen fixation by pasture grass-bacteria association, plant-bacteria specificities and effect of environmental stress on nitrogen fixation.	1. Survey literature on nitrogen fixation by grass-bacteria association. 2. Undertake field assessment of nitrogen fixation according to plant, bacteria and environment. 3. Survey literature on effects of grass produced phytotoxins on nodulation and nitrogen fixation in pasture legumes. 4. Identify, quantify and test toxins.	1. Exhaustive literature survey has been conducted. 2. Four scientists, Dr. R. Burris, Dr. R. Smith, Dr. S. Schenk and Dr. R. Weaver, have been consulted.	1. A one month visit planned by Dr. B. B. Bohlool to Dr. J. Döbereiner's laboratory Km 47, Brazil, under the sponsorship of USNAS-EMBRAPA.

211(d) Institutional Grant
Project Design Summary

Project Title: Mineralogy and Microbiology of Tropical Soils

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	REPORTING YEAR ACHIEVEMENT	FUTURE PLANS, REMARKS
Outputs: B. Bohlool Output No. 1. Expanded Knowledge			
Evaluation of the role of mycorrhiza on legume nitrogen fixation in low phosphate soils.	1. Survey literature on endogene on legumes.	1. Dr. B. Mosse, Rothamsted Experimental Station, England, was employed for 3 months as a consultant to assist in the preparation of SOTA. Text on SOTA has been completed.	1. Final draft of SOTA should be ready for review by October.
3. Microbiology as a limiting factor a. Micorrhiza association	2. Assess and measure potential of phosphorus uptake and subsequent effect on nitrogen fixation and protein production.	2. Dr. B. Mosse conducted a two-day training workshop on mycorrhiza for 10 U.H. faculty and graduate students.	
		3. Dr. Mosse consulted with research projects at U.H. which are related to the interaction of mycorrhiza with symbiotic N_2-fixation in tropical soils.	
		4. Dr. B. Mosse surveyed several Hawaiian plants for incidence of mycorrhizal infection.	

3) A one month visit to Dr. J. Döbereiner laboratory, Km 47, Brazil, is planned under the sponsorship of USNAS-EMBRAPA.

b. Mycorrhizal Association

Dr. Barbara Mosse, Rothamsted Experimental Station, England, was employed for three months as a consultant to assist in the preparation of SOTA. The text of the SOTA has been completed, but figures and legends still need to be incorporated. The final draft should be ready for review by September or October.

A training workshop entitled "Techniques and Application in Mycorrhizal Research" was organized for ten U.H. faculty and graduate students. The two-day lecture and laboratory sessions were directed by Dr. Mosse and assisted by Dr. O. Holtzman, Department of Plant Pathology, U.H.

While at the U.H., Dr. Mosse was also involved in consulting with several research projects related to the interaction of mycorrhiza with symbiotic N_2-fixation in tropical soils. She also found time to survey several Hawaiian plants for incidence of mycorrhizal infection. She found pineapple roots to be strongly mycorrhizal, with nearly 100% of roots and cells heavily infected. Soils from pineapple fields contained large numbers of different types of VA mycorrhizal spores. Papayas were also found to be heavily mycorrhizal with exceptionally well-developed arbuscules.

4. The soil as a limiting factor

a. Soil stresses (lead scientist: Y. Kanehiro)

The genetic potential of yield and quality of a plant is presumably achieved under ideal environmental conditions. However, ideal environmental conditions are hard to define and difficult to achieve. The departure of components of the environment from the theoretically perfect combination is

called stress (Lewis, 1976)[1]. Stress may be due to climatic or soil factors. In symbiotic associations, the effect of environment may be on the host plant or the rhizobia. The preparation of the state-of-the-art documents on soil-related stresses as they affect biological nitrogen fixation (BNF) in tropical pasture legumes is the main objective of our interest.

The main effects of soil acidity may be compounded by a number of factors: low pH, excessive levels of Mn and/or Al and deficiency of Ca, P and/or Mo. These components may affect the performance of rhizobia, the nodulation and N fixation process and the host plant[2].

pH:

Norris (1956, 1959) indicated that tropical legumes are generally more tolerant to soil acidity than temperate legumes. However, recent studies have shown that within both groups, different plant-pH interactions occur (Andrew, 1976; Loneragan, 1973; Munns et al., 1977).

Aluminum:

Andrew et al (1973) reported that dry matter production of *M. lathyroides*, *L. bainesii* and *S. humilis* were not depressed up to 2 ppm Al in solution and that of *D. uncinatum* was depressed at 2 ppm but not at 1 ppm or less concentration. Growth of *G. wightii* was severely depressed even at 0.5 ppm Al.

The differences in response to Al tolerance by plants might be due to

(i) organic acids produced to act as chelating agent to Al (Jones, 1961);

(ii) ability of some plants to change rhizosphere pH (Foy et al, 1965);

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[1] For brevity, only name(s) and year will be given in this report.

[2] For some supporting material to this report, refer to the Annual Report 211(d) for 1976-77; pages 32-37.

(iii) Al-organic acid complexes resulting in detoxification (Clarkson, 1966); (iv) cation exchange capacity of roots (Vose and Randall, 1962); (v) differences in Al exclusion from uptake or its translocation to plant tops (Andrew et al, 1973; Munns, 1965).

Calcium:

Among the tropical legumes used by Andrew (1976), calcium requirement for optimum growth of nodulated plants in solution culture was 0.25 me/l.

The positive response to liming in various studies might be due to the Ca and Mg supply (Spain et al., 1975), decrease in H^+ ion concentration (Munns and Fox, 1977), decrease in soluble Al and Mn levels, better P nutrition and an increase in Mo availability. Liming of Oxisols and Ultisols to a pH of 5.5-6.0 is suggested (Adams, 1978) to eliminate probably Al toxicity, and improve the supply of Ca, Mo, P and S.

Nodule bacteria are sensitive to the same acid soil-infertility factors as their host plants. However, they are often less sensitive to Al, Mn, and Mo than are their host plants (Lonergan, 1972) but may be more sensitive to H^+ ion concentration (Loneragan and Dowling, 1958). Species of rhizobia are known to differ in their tolerance to soil acidity (Vincent, 1965). The slow growing types are more acid tolerant than the fast growing types. Mineral nutrition requirement of rhizobia is a major area of ignorance.

Phosphorus:

The critical level of 20 ppm P (Olson's method) was reported for the establishment of grass-legume pastures (Bruce and Bruce, 1972), 10-14 ppm for established *M. atropurpureum* pastures (Rayment et al., 1977) and 6 ppm for *S. humilis* pastures (Robertson et al., 1976). Fox et al (1974) reported P concentration requirement for 95% maximum yield of Desmodium spp. to vary from 0.20 to 0.01 ppm at establishment and at 3 months, respectively.

Molybdenum:

Responses to Mo as a fertilizer for legumes have been widespread, especially in Australia, New Zealand and U.S.A. Liming seems to ease the deficiency of Mo in acid soils. Mo, Cu and Co are some of the nutrients whose requirements for nodule function far exceed their requirements elsewhere in the plant.

Very little information is available on Mo sorption characteristics of the tropical soils. There is also need to determine critical Mo concentrations for N fixation by the legumes.

Soil N:

A generalized picture of the effect of combined N on BNF is given in Fig. 1.

The results of various researchers show that the relationship between combined N nodulation are quite complex. Host species, the type of bacteria, the form, rate and method of fertilizer application and the environmental conditions should be considered. Very little information is available on the nutritional requirements of established pastures. A very general picture of the adaptabilities of tropical pasture legumes to various soil conditions is given by Sanchez (1976). Literature search revealed that the critical concentrations of P in *S. humilis*, *C. pubescens* and *D. intortum* were 0.24, 0.16 and 0.22% respectively. The values for K were 0.6, 0.75 and 0.72% in the three legumes; and for Mn, the critical concentrations were 1140 and 1600 ppm in *S. humilis* and *C. pubescens*, respectively.

Greenhouse Studies

A greenhouse experiment was conducted to see the effects of 0, 50, 100 and 200 kg N/ha application from urea, sulfur-coated-urea (SCU), isobutylidene

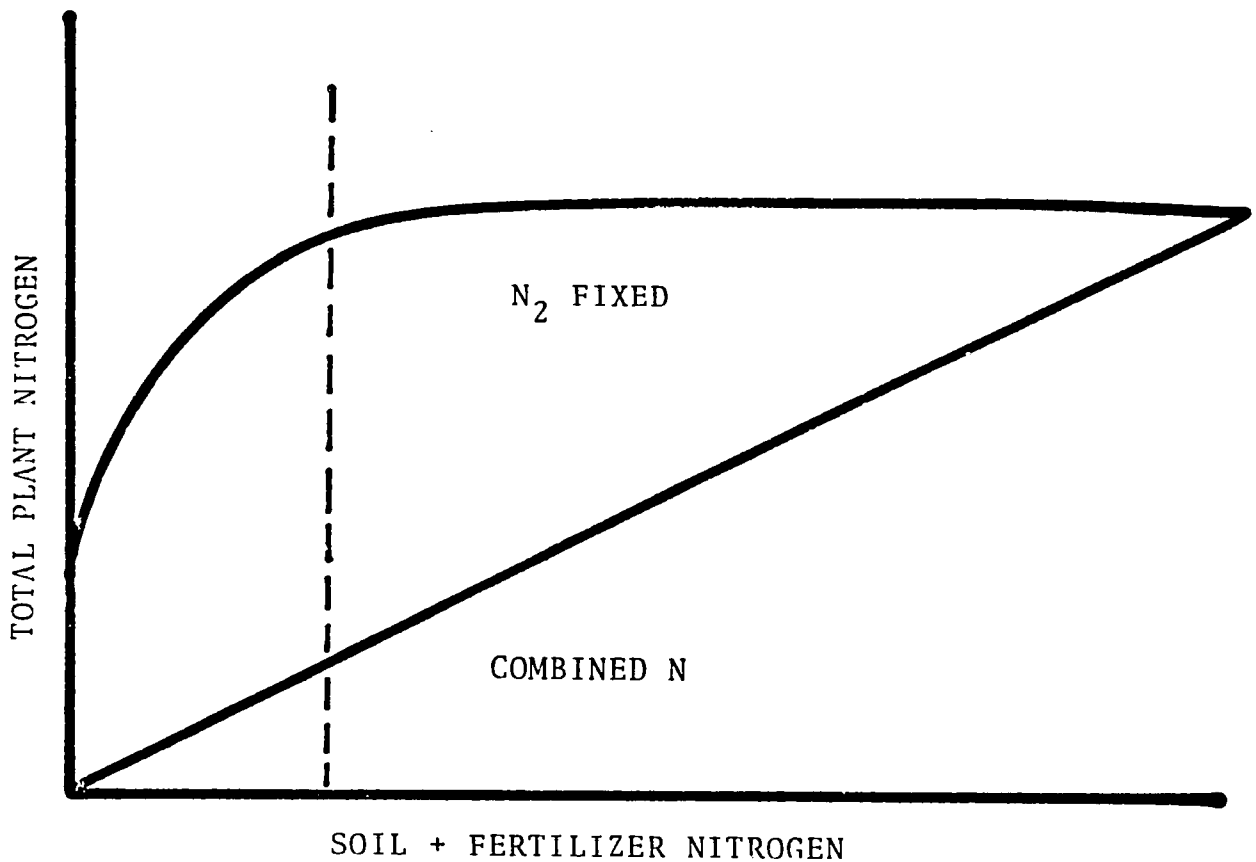

Fig. 1. Diagramatic representation of the effects of combined nitrogen (soil plus fertilizer) on the nitrogen assimilation by legumes over a growing season. (after Gibson, 1977).

diurea (IBDU) and KNO_3 on Centrosema pubescens growth and nodulation in the Paaloa series (Humoxic Tropohumult).

Increasing N rate increased the dry matter from 26.4 g/pot in the control treatment to 28.0, 32.1 and 36.6 g/pot at 50, 100 and 200 kg N/ha treatments, respectively. The differences in dry matter yield among various sources of N fertilizer were not prominent. Nodulation was very poor in all treatments. It seems that low soil pH was the main cause of poor nodulation. Investigations are underway to find out the reason for such results. It is interesting to see that the average number of nodules was highest in the control treatment followed by SCU, IBDU, KNO_3 and urea fertilizers.

A preliminary study was conducted to investigate the effects of Mo and tryptophane addition on C. pubescens in the Wahiawa series (Tropeptic Eutrustox). Tryptophane is an amino acid, and like indole acetic acid, has been reported to increase friction of root hairs by rhizobia and thus increase nodulation. Mo was applied at the rate of 2 kg/ha and for tryptophane treatment, seeds were soaked in a 0.1% solution.

The dry matter yield of tops was 19.7, 20.2, 19.6 and 18.0 g/pot in control, Mo, tryptophane and Mo plus tryptophane treatments, respectively. For these treatments, the number of nodules/pot were 262, 228, 264 and 201 and the fresh weight of nodules was 4.69, 5.21, 4.92 and 4.18 g/pot.

Application of Mo plus tryptophane decreased the dry matter yield and nodulation. Reasons are not clear. A more detailed study of Mo-lime interactions is planned in the near future.

South American Visit

The project leader visited CIAT in Cali, Colombia and EMBRAPA-SNLCS-Km 47 in Rio de Janeiro, Instituto Agronomico in Campinas, Instituto de Pesquisas

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NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	REPORTING YEAR ACHIEVEMENT	FUTURE PLANS, REMARKS
Outputs: Y. Kanehiro			
Output No. 1. Expanded Knowledge			
4. The soil as a limiting factor	1. Identify collaborators prepare SOTA outline, assign tasks.	1. Contacted two institutions in Australia, in Colombia and four in Brazil and received information on BNF. Visited CIAT in Colombia, EMBRAPA in Rio de Janeiro and Brasilia, Instituto Agronomicao in Campinas, IRI in Matao, Instituto de Zootecnia in Nova Odessa and INPA-CNPQ in Manaus to confer with scientists working on BNF. In preparation of SOTA outline, the following work was carried out:	
a. Soil-related stresses Assess the role of soil-related factors limiting biological nitrogen fixation and protein production in the tropics.	2. Assess effects of soil acidity on biological nitrogen fixation.	2. Literature surveyed. Requested and received information on BNF on tropical soils from scientists in above-mentioned countries and elsewhere.	
	3. Assess effects of soil temperature on biological nitrogen fixation.	3. Same as No. 2.	
	4. Assess effects of micronutrient deficiencies on biological nitrogen fixation.	4. Same as No. 2 on literature survey. Greenhouse experiment on effects of Mo and tryptophane were carried out with C. pubescens.	

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	5. Assess effects of phosphorus deficiency on biological nitrogen fixation.	5. Same as No. 2.	
	6. Assess role of fertilizer nitrogen on biological nitrogen fixation.	6. Same as No. 2 on literature survey. Greenhouse experiment on effects of different rates of various N carriers on C. pubescens growth and nodulation. Many of the pasture and forage legumes which have historical roots in Australia and Africa do not perform well in vast areas of South America, where the climate is humid and the soil very acid and infertile (e.g. the Llanos Orientales). A primary concern is to broaden the germ plasma bank of promising legume species. Another major endeavor is breeding toward stress tolerance. Perhaps more attention needs to be given to this aspect when considering that fertilizer and lime inputs could be minimal in many developing countries of the tropicas because of economic considerations.	

(IRI) in Matao, Instituto de Zootecnia in Nova Odessa, EMBRAPA-CPAC in Brasilia and Concettro Nacional de Pesquisas (INPA-CNPQ) in Manaus, Brazil. The purpose of this visit was to confer with scientists working on tropical legumes and related subjects.

One of the primary aims of the CIAT researchers is to find a forage legume that is adaptable to the high acid/Al and related soil conditions associated with the Llanos Orientales type of soils and at the same time will grow in compatibility with two important grasses of the region, Brachiaria decumbens and Andpropogon gayanus. The problems facing those working with cerrado soils in Brazil are in many ways similar to those of the Llanos, but not entirely in that the cerrado soils are likely to be less acidic and are associated with a less humid climate than the Llanos.

b. Allelopathy (lead scientist: D. Bartholomew)

During the summer of 1977, a study tour was arranged by the East-West Center for Mr. C. C. Young to visit and participate in several activities relating to research on allelopathy and biological nitrogen fixation. Mr. Young participated with Dr. E. L. Rice, a world authority on allelopathy at the University of Oklahoma, in a project dealing with the causes of a decrease in productivity in an undisturbed tall grass prairie in Oklahoma. He also traveled to Cornell University where he visited the laboratory of Dr. W. Duke and discussed current research on allelopathy. Mr. Young attended a symposium on allelopathy which was organized by Dr. Rice and held at Michigan State University and spent an additional week at the National Agricultural Library, Washington, D. C. working on the literature review for the state-of-the-art report on allelopathy in grass-legume associations. The literature search for the SOTA has been completed and the report is in the final writing stage.

Research on the nature of the allelopathic inhibition of Desmodium intortum by Hemarthria altissima (big alta limpograss) continues. Greenhouse experiments in pots with soil conducted since 1976 have shown conclusively that inhibition of intortum by big alta limpograss was due to the production of toxic compounds. In tests where the grass was growing in vermiculite in the same glazed pot as intortum but separated from it by a divider, leachates from the grass reduced the fresh production of intortum to one-fourth of that for plants grown in the absence of the leachate. When growth was expressed as plant height, the growth of intortum in the presence of the leachate was reduced to half of that for plants grown in its absence. In bioassay tests, extracts of the roots of big alta limpograss reduced the root growth of lettuce seedlings to 50 percent of the distilled water control at 1 milligram fresh root per microliter of water. The big alta limpograss extracts were significantly more toxic than were extracts from intortum or green alta limpograss.

The effects of the addition of roots of intortum, big alta and green alta limpograsses to soil on the population of soil microorganisms and the activities of several enzymes commonly found in soil have been studied. The addition of all roots to the soil caused an increase in the population of bacteria and fungi present and resulted in increased CO_2 evolution from the soil. The activities of amylase, cellulase, invertase, and dehydrogenases were higher with the addition of roots of intortum than with the addition of roots of either of the two grasses. Where big alta limpograss roots were added to the soil, the activities of amylase and cellulase were not significantly different from levels found in the control soil to which no roots had been added. A possible explanation is that the products from big alta limpograss root decomposition inhibited the activity of amylase and cellulase in the soil or prevented the release of enzymes from soil microorganisms during the period of incubation.

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utputs: D. Bartholomew			
utput No.I. Expanded Knowledge			
4. The soil as a limiting factor.			
b. Alleopathy and nitrogen fixation.			
Evaluation of the role of plant produced phytotoxins on nodulation and nitrogen fixation by pasture and forage legumes.	1. Survey literature on effects of grass produced phytotoxins on nodulation and nitrogen fixation in pasture legumes. 2. Identify, quantify and test toxins.	1. A first draft of the literature survey on effects of grass produced phytotoxins on nodulation and nitrogen fixation in pasture legumes has been completed. 2. The existence and education of inhibitor(s) from a forage grass and their inhibition of plant (including a forage legume) growth has been confirmed. A method has been devised to isolate and collect the inhibitor(s) for characterization.	1. The literature survey will be finalized and the completed document submitted within the next few months. 2. The collected toxin(s) will be identified and work will begin on the characterization of the mechanism of physiological activity.

c. Soil Erosion (lead scientist: S. El-Swaify)

Retrieval of published information on soil erosion by water was carried out by on line computer search from three separate sources. These are CAIN, now called AGRICOLA, (which taps the National Agricultural Library), BIOSIS (which taps the bibliography compiled by the Commonwealth Agricultural Bureau). In addition, valuable though yet unpublished information was collected both through correspondence with concerned focal points, attendance of the U.S.-Europe Workshop on Soil Erosion (Ghent), conferring with the FAO team conducting the global mapping of land degradation, and by site visits to several countries. Final designs for study on the protective effects of various vegetative covers have been drawn and the experiment will begin in the latter part of this summer.

Information collected from the above sources has been classified geographically by continents, regions, and countries, as well as by topics and sub-topics covering the scope, extent, impact, predictive parameters, control measures, and research needs related to erosion problems in the tropics. Analysis of this information reveals the following:

1. Assessment of erosion extent has been conducted by workers at various scales. FAO's global assessment of land degradation (including erosion) hazards is more concerned with broad generalization than with detailed or site specific problems. These types of studies are not reliable as they necessarily rely on gross approximations because the existing data base is too limited to to be of universal applicability. On the other end of the scale there are efforts which more correctly attempt an inventory of the problem based on detailed studies involving defined watersheds or sub-watersheds. Such designed studies have been more frequently conducted under natural than artificial (simulated) rainfall conditions.

2. More information on soil erosion was generated from the tropical regions of Africa than from other tropical regions. A comprehensive bibliography for that continent is now on hand and its publication as a separate entity is being considered.

3. The sediment loads of rivers and streams are frequently used as a basis for estimating soil erosion from the land surface. This confusion of sediment delivery with soil losses disregards the now well known fact that sediment delivery into surface streams represents only a fraction of actual soil loss caused by erosion. Because the fraction becomes increasingly smaller with increased watershed size, this approximation is particularly misleading for watersheds or river basins of large size. Also this approach tends to even out the erosional losses from different sources and therefore underestimates the seriousness of the problem in areas where corrective actions are needed the most.

4. The data on the impact of top soil loss on soil productivity indicate that yield reductions due to erosion depend on soil type and topographic setting, the initial soil fertility status, crop type and rotation, as well as soil depth. When erosion is so severe as to involve removal of infertile subsoils, the productivity of low-lying lands where these erosional sediments are redeposited is also reduced.

5. Reservoir and dam siltation by sediment is a serious erosional impact in some countries (e.g. Egypt, India and Tanzania). However, the impacts of corrective measures are rather complex because not only sediment load but also water yield of a river may be reduced by erosion control in upstream watersheds.

6. The roles of causative factors for soil erosion by water are generally well understood. However, there are critical knowledge gaps for tropical

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Outputs: S. A. El-Swaify			
Output No.I. Expanded Knowledge 4. The soil as a limiting factor c. State-of-the-art on soil erosion (cooperative effort with University of Arizona).	1. Identify locations with valid information on soil erodibility, rainfall erosivity, and on effects of topography, crop conditions, and land management on soil losses by water erosion.	1. Tropical regions of Africa provided more published information than other tropical regions. A comprehensive bibliography on Africa is near completion. Much non-published information has also been compiled. Wind erosion is a very significant problem in many arid and semiarid tropical and sub-tropical countries. One workshop attended, two site visits undertaken, and one consultant acquired.	1. Further site visits for information retrieval are planned for late summer 1978. First draft of SOTA report planned for Fall, 1978. The comprehensive bibliography on Africa will be completed and possibly published separately.
	2. Interpret data on factors affecting soil erosion in the tropics.	2. Climatic aggressivity indices commonly used in temperate regions have questionable value for tropical storms. Alternative indices are available but their validity for the tropics needs investigation.	2. Consultantship(s) will be contracted to assist with report completion stages.
	3. Cooperative field tests in selected locations where data is lacking or insufficient.	3. Cooperative experimental plans are delayed for now.	3. No joint experimental plans contemplated for this phase.

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		4. Limited data have been "uncovered" for some red tropical soils which indicate that effects on crop yield depend on soil type and depth, topographic setting, initial fertility status, and crop types and rotations.	4. Continue efforts to retrieve more such information from tropical areas and determine essential research needs for SOTA analysis.
	5. Field tests to collect such data for selected locations where not available.	5. A design for a study on Molokai has been completed.	5. Molokai study will be started in late summer, 1978.

regions particularly as regards climatic aggresivity, soil erodibility, topography, and protective effects of vegetative covers. The rainfall erosion index (EI_{30}) which is commonly used by American workers in applying the universal soil loss equation is difficult to derive for most LDC's as it requires detailed monitoring of individual rainstorms at frequent intervals. The index is also of questionable applicability for intense tropical storms. Other indices, including Fournier's index, Hudson's KE>1, and Lal's AI, have been used instead to describe rainfall erosibity. Similarly, due to lack of experimental data on the susceptibility of tropical soils to erosion, erodibility indices instead of erodibility values have been used by many workers. This may explain why similarly classified soils in various regions have been reported to possess different inherent resistance to erosion.

7. Although physical factors are directly responsible for soil erosion, these are modified by socio-economic variables, which in tropical countries relying on subsistence agriculture are very strong. The clearing of forests in many of these countries is frequently justified by the increasing population pressures and the need to put more land under cultivation for crop production. The lack of reliable or accessible sources of fossil fuel is caused for continued exploitation of forests for fire wood. Frequently, as in the Caribbean Islands and Andes, the steep hilly lands cleared for cultivation have slopes of up to 45 degrees (100%), a practice which clearly invites massive erosion problems.

B. Information Capacity

1. Retrieval System (lead scientist: P. Rotar)

Retrieval for selective dissemination of information (SDI) continues routinely on the profile topics of phosphorus, acid soils, rhizobium inoculation, and pasture legumes, while bibliographic work has been concentrated on the

development of the Forage Legumes and Phosphorus Nutrition bibliographies. Machine searches of 3 files have been performed for a number of local researchers and international centers have been approached to determine their information needs. Additionally, a set of "mini-bibliographies" have been created in the area of pasture legumes, and a reprint file has been assembled for research in phosphorus nutrition.

The first file, "Legumes I," has been expanded to add an update of 1977's citations from the records of three computerized data bases: AGRICOLA (National Agricultural Library), BIOSIS (Biological Abstracts), and CAB (Commonwealth Agriculture Bureau). Citations resulting from continued manual searches of the period previous to 1977 were added as well, for a total of 1020 citations. These 220 added citations were keyworded, titles were expanded to full text, and the citations were input and integrated into the original machine readable file. This file can be machine searched by title, authors' names, year of publication, source of publication and keywords. Additionally, printed copies of the whole file and author, keyword and KWIC (Key Words In Context) indices have been made for "browsing" or manual search. The UNISORT manual sort system and abstracts are available as well, on new citations as well as old.

The second file, "Legumes II," has also been expanded to include 1977's citations from the same three data bases and to increase the number of citations gathered from other sources and pertaining to the period previous to 1977. This file now totals 1304 citations. The 554 new citations were keyworded, the source field expanded and the citations were input and added to the original Legume II materials in both the machine reable and card files. The file is machine searchable and is also available, with indices, in printed form. The UNISORT card file with abstracts has also been expanded.

The original Phorphorus file contained 1700 citations relevant to phosphorus availability in tropical soils and several hundred additional citations were available each month. This size soon made use of the file extremely difficult. A decision was reached by the primary users of the file that a smaller number of more directly relevant citations would be preferable to a greater number of citations, many of which were marginally relevant. Thus, the original 1700 citations were "weeded" to form the "Extracted Phosphorus" f of 820 citations. Then, using the new, tighter criteria, 1096 additional citations, including material published between 1970 and 1977 and recovered from a number of sources, were added to the extracted file. This file now contains 1916 citations and is machine searchable. The citations also are available in a bibliographic print-out, but the size of the file prohibits easy manual search.

A number of "mini-bibliographies" have been created for research needs out of the Legumes I and II files. These deal with specific approaches to the pastur legume research, for example: seed technology, climate, season, livestock, geographical locations, etc. These are working copies and include the citations, abstracts and additional notes.

To survey some of the more important literature in tropical phosphorus research, a reprint file of over 500 pieces has been gathered and filed. Those articles which are available in reprint form are noted on the master file so that a researcher pursuing a topic can recognize those pieces which are immediately available.

During the year a number of searches have been conducted for local personnel on Oahu, Kauai, and the island of Hawaii. These have ranged in size from searches of only a few terms to very extensive searches using many search terms and three of the five fields. Mrs. Barbara Bird of the Bibliographic Information Service

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Output: P. P. Rotar			
Output No. II. Information			
Collection, evaluation, storage and dissemination of useful, updated information related to microbiology and mineralogy of tropical soils, and which bear on problems and conditions in developing countries of the tropics and subtropica, and linkage to CID and Hawaii SOIL DATA BANK.	1. Search and inventory Africa (French and British), Latin and Central America, Australia, FAO, USAID, international centers, LDC records and files for data on microbiology (biological nitrogen fixation) and mineralogy (phosphorus unavailability in tropical soils).	1. Searches are continually being updated and information provided to project staff.	1. Current awareness to be continued. Searches to be made on new topics as need arises.
	2. Evaluate and organize data into form for easy electronic dissemination to LDCs.	2. Data files are on magnetic type and are available for search and distribution to interested individual.	2. Data files to be prepared for publication.
	3. Explore linkage mechanism with CID.	3. Linkages developed with international centers through extended visit during February-March, 1978.	3. Continued expansion of linkages established.

(Project 172) visited the international centers of tropical agriculture and discussed the 211-d files with key personnel at each station. One search had been conducted on the basis of these contacts--for AVRDC. A description of the files and procedures for searches was written and distributed to the international centers to follow up and reinforce the initial verbal contacts. A search term glossary for each file is available to all interested persons as well.

2. Soil Data Bank (lead scientist: H. Ikawa)

One of the major endeavors of the fiscal year was to start revising the format of the Hawaii Soil Data Bank to conform to the format of the National Pedon Coding System of the Soil Conservation Service (SCS), USDA. Because there are several data banks throughout the country, there is a distinct advantage in having the Hawaii data bank being compatible with that of the national system. There can be ready exchange of information and elimination of unnecessary duplicating efforts. For the purpose of revising the system, the soil scientist in charge of the pedon coding system at the National Soil Sruvey Laboratory, SCS, in Lincoln, Nebraska, visited Hawaii for one week to help implement the change. In making this change, Hawaii benefited by receiving all of the existing computer programs associated with the Pedon Coding System. In return, Hawaii has suggested several improvements to the system. When completed, the revised Hawaii Soil Data Bank will be able to store and retrieve the numerous soil survey data of the key LDC research stations and of the international agricultural centers for soil interpretation and land use planning. These data will then be available to interested parties.

International soil classification conferences were attended in Brazil and Malaysia. During the field trips, there were opportunities to study various soils, in particular the Oxisols, Ultisols, and Alfisols. Laboratory data and

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Outputs: H. Ikawa Output No. II. Information Capacity Inclusion of soil survey data of key LDC research centers and international centers into existing soil data bank for purpose of intra- and inter-LDC agro-technology transfer through soil surveys and soil classification systems.	1. Identify about 15 key LDC and international agricultural research centers with strong or potentially strong programs. 2. Visits by U.H. staff to sites for inspection and collection of soil survey data. 3. Classify soils according to U.S. Department of Agriculture Soil Taxonomy. 4. Feed data into soil data bank.	1. Revision of the soil data bank is nearly complete. Laboratory data and soil descriptions of selected soils of Brazil, Malaysia, Thailand, Liberia and Cameroon as well as of Costa Rica and the Philippines were received or have been characterized for inclusion into the soil data bank. 2. Brazil, Thailand, Malaysia, Indonesia, Cameroon, and Nigeria visited. 3. All data collected were classified according to Soil Taxonomy. 4. All data are ready to be stored into the revised soil data bank. 5. Data retrieval and interpretation capability established.	General Remarks In the near future, as part of the data dissemination service, laboratory data and descriptions of soils can be compiled, retrieved, and printed by the computer according to new format. Initial output is a publication of 17 pedons representing the 22 experimental sites of the Benchmark Soils Project. In cooperation with Univ. of Puerto Rico, a proposal has been submitted to USAID/Wash., D.C., suggesting the need to conduct detailed soil surveys at each of the international agricultural centers.

the descriptions of the soils were obtained and the information is ready for input into the revised soil data bank.

During the visit to Thailand, arrangements were made to obtain the laboratory data and the descriptions of the Typic Paleudults from four research stations. Subsequently, information on eight pedons were received. Four of them appear to be in the same family of the Typic Paleudults being tested by the Benchmark Soils Project in the Philippines, Indonesia, and Cameroon.

The mineralogical analysis for the International Soil Classification Workshop in Brazil has been completed with the addition of 32 horizons (silt and clay fractions) representing 14 pedons to the original 18 horizons representing 17 pedons. The completed data for the 31 pedons, including photographs of the X-ray traces, were then compiled for the workshop manuscript now in preparation.

Mineralogical analysis was also performed for various organizations to aid in the classification of soils at the family category of Soil Taxonomy. Some of these organizations were the University of Puerto Rico, Centro Agronomico Tropical de Investigation y Ensenanza in Turrialba, Costa Rica, and the International Rice Research Institute in Los Banos, the Philippines. In exchange, Hawaii was provided some pedon data for its data bank.

During the trip to Cameroon for the purpose of confirming the experimental site for the Benchmark Soils Project, three pedons were sampled. These pedons, together with others from the general area, have been characterized and the data are ready for input into the data bank.

C. Education and Training Capacity (lead scientist: R. Green)

The development of an audio-visual self-tutorial system for use in teaching the fundamentals of soil science in developing countries has continued during

the second year of the project. The project work will be about 35% complete by the end of this project year.

This year's activities involved both software (subject matter units) and hardware (equipment and facilities) development for the pilot program to be established at the University of the Philippines, Los Banos. A total of ten software units will be completed by the end of the project. Tape texts, work books and visual materials have been completed for 7 units. Procurement of audio-visual equipment to accommodate 24 students at one time (12 setups with 2 students each) is nearly complete. An AV room with appropriate facilities is being developed by UPLB. It is anticipated that the pilot program in the Department of Soil Science UPLB will be implemented by November or December 1978.

The ten subject matter units being developed for use in the Philippines are:

1. Concepts of Soils
2. Weathering and Soil Development
3. Bulk Density, Pore Space, and Air Relationships
4. Soil Moisture Tension and Air-Water Relationships
5. Nature, Structure, and Characteristics of Soil Colloids
6. Cation Exchange Capacity, Anion Adsorption Capacity, and Ion Exchange in Soils
7. Soil Testing--A Means to Fertility Evaluation and Fertilizer Recommendations
8. Soil and Fertilizer Nitrogen
9. Soil and Fertilizer Phosphorus
10. Chemistry of Paddy Soils

211(d) Institutional Grant
Project Design Summary

Project Title: Mineralogy and Microbiology of Tropical Soils

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	REPORTING YEAR ACHIEVEMENT	FUTURE PLANS, REMARKS
Outputs: R. E. Green			
Output No. III. Education and Capacity	1. Negotiate agreement with two LDC institutions to evaluate teaching package; procure equipment and supplies for development and evaluation of AV units.	1. Arrangements were made with UPLB 8/76 for cooperative effort; photographic equipment obtained for taking slides.	1. Program to be initiated at UPLB in Nov.-Dec. 1978.
Test and evaluate audio-turotial teaching package designed for undergraduate students in tropical developing countries.	2. U.H. staff visit LDC contacts to initiate cooperative effort and obtain useful visual materials (especially photographs) of local environs for AV units.	2. Project leader conducted workshop 11/76 at UPLB on development of AV teaching units; plans for a joint project were developed.	2. Evaluation visit is scheduled for Spring 1978, along with a workshop at UPLB for teachers from other Philippine institutions.
	3. Recruit two graduate students preferably one from each of two LDCs, and initiate development of six AV units.	3. Post-doctoral assistant was hired for 8 months in lieu of graduate students; 4 new AV units developed and 1 revised as of 6/77.	
	4. Secure services of a consultant on developments of AV units on soil/crop management of specific utility in LDCs.	4. Dr. Angelina Briones, UPLB, came to Hawaii for 4 months, Feb.-May 1978 to accomplish find preparation of AV units for use at UPLB. All equipment has been procured or ordered.	

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Units 1 through 5 were adapted for use in the Philippines from material currently used in teaching the introductory Soil Science course at the University of Hawaii Units 6 through 10 are being developed in their entirity under this project. Dr. Muhammad Mukhtar, project associate, for 8 months, contributed substantially to several units, and Dr. Angelina Briones of the Department of Soil Science, UPLB, came to Hawaii for 4 months as a consultant to the project to complete the software.

The remaining project work includes implementation of the pilot AV self-tutorial program and its evaluation at UPLB, plus the conduct of a workshop at UPLB on self-tutorials in soil science to extend the information and experiences of this project to other instutitions in the Philippines. The anticipated time for the workshop is Spring 1979.

D. Advisory Capacity (Chairman of Department, Grant Project Director)

Excluding normal grant-related activities, University of Hawaii scientists have contributed about 9.5 man months to international development activities. Faculty members who have been heavily involved in advisory roles are Drs. B. Bohlool (1 month), D. Plucknett (3 months), P. P. Rotar (1 month), J. A. Silva (1.5 months), A. S. Whitney (2 months) and G. Uehara (1 month).

In addition to advisory roles, the faculty has traveled in the tropics to serve and collect data for seven state-of-the-art reports. The faculty spent about 12 man months on international travel for this purpose. While the SOTA reports served as the main justification for travel, increased faculty awareness of developing country problems and conditions has added to the instututions development support capacility.

The value of international travel for faculty and staff is exemplified by a travel completion report submitted by Mrs. Barbara Bird, Assistant Researcher,

University of Hawaii at Manoa

College of Tropical Agriculture
Department of Agronomy and Soil Science
3190 Maile Way • Honolulu, Hawaii 96822
Telephone: (808) 948-7530 • Cable Address: UNIHAW

May 11, 1978

MEMORANDUM TO : W. R. Furtick, Dean

VIA : P. P. Rotar, Chairman P. P. Rotar
Department of Agronomy and Soil Science

N. P. Kefford, Associate Director

FROM: : B. K. Bird

SUBJECT: : Narrative Report of International Travel

DATE OF TRAVEL : February 8 to March 23, 1978

PURPOSE OF TRAVEL:

1. To explore the information needs of the programs and community of each center;

2. To view existing resources--materials, facilities, professional library skills;

3. To examine the possibility of coordination in providing agricultural information to support the needs of developing countries and especially projects dependent on U.S. funds;

4. To present to the communities of each center the capabilities of our service and special advantages for areas remote from conventional information services;

5. To discuss improvement and continuance of present SDI service as well as charge policy--AVRDC, UPLB and IITA; and

6. To assess need for:
   a. document delivery or alternative "back-up" facilities, e.g. facsimile transmission, and
   b. development of satellite communications for an agricultural information network among international centers.

"AN EQUAL OPPORTUNITY EMPLOYER"

ACCOMPLISHMENTS AND BENEFITS:

PHILIPPINES, February 9-15, 1978

Following Dr. Rotar's visit to the nation's primary center for agricultural education, the University of the Philippines at Los Banos, I had visited the same campus early in July, 1977, when many faculty were introduced to our SDI service. This current visit therefore provided opportunity for departmental and individual follow-up as well as discussion with Dr. Fernandez, assistant dean of the College of Agriculture, and with Dr. J. Drilon, director of SEARCA (South East Asia Regional Center for Agriculture), regarding continuation of the program. At all levels, there was enthusiasm for continuation even if a charge to meet postage and tape lease were necessary. With a charge service, however, I would expect some consolidation of "profiles." Patrons valued the service, even though as some said, they often could not obtain cited materials at the UPLB Library, the prime agricultural collection in the country. Generally speaking, while UPLB Library subscribes to major indexing and abstracting services, the range of serial subscriptions is not great. Moreover, possibly due to lack of funds, binding of a major resource such as Biological Abstracts is tardy, the latest bound volume being v. 59 (mid 1975) with subsequent issues already shedding pages. It was frequently remarked that if a needed item is not at UPLB Library, there is virtually no hope of finding it within the country. This is a national problem, not easily or quickly remedied. However, provision of abstracts is helpful, and access to prompt document delivery service would certainly ease the situation.

In regard to meeting their document delivery costs, it was suggested that SEARCA might be approached, and PCARR, whose mission is to facilitate acquisition of agricultural information, may also be an internal source of assistance in procuring photocopies, etc. from outside the Philippines.

IRRI, which adjoins the UPLB campus, has an excellent library developed to support the specialized needs of the Institution. A well maintained and comprehensive monograph and serial collection in association with major abstracting and indexing services, is available to the IRRI community and in contrast to UPLB, shows no sign of stress, though the facility is very well used. Nor is there apparently difficulty in procuring additional materials if requested. For several years, a Wang computer installation (with highspeed printer, plotter, cassette tape CRT and card reader) has most adequately served fiscal management, administration, stores research analysis and the Germplasm Bank; but computer application in the IRRI library is not contemplated.

IRRI does however contribute along with PCARR, SEARCA and UPLB in supporting ARC, the Agricultural Resource Center, an IBM equipped Campus Computing Center, directed by Dr. N. Ison and intended to provide services such as fiscal management, statistical analysis, etc. Since AIBA (part of SEARCA) is the regional input center for AGRIS, they have begun to utilize the computer for bibliographic organization.

Several difficulties are obvious:

1. Electricity supply throughout the Philippines is erratic; in fact, during my discussions with the Director of the Computing Center, the power failed.

2. Telecommunications are also notoriously unreliable; telephone communications within the Campus is intermittent and is not expected to be dependable; radio call is installed by many organizations as an effective alternative to the telephone. Consequently, remote entry to the Computer Center is unthinkable, and all terminals must be hardwired. Until problems 1 and 2 are eliminated, there is no chance of online access to databases provided by vendors such as Lockheed (DIALOG) or System Development Corporation (ORBIT).

3. Expertise--programmers, analysts, technicians, consultants--is scarce.

4. Software, other than IBM, even if known to exist, is not readily available. (For bibliographic purposes ISIS developed by IDRC is available to developing countries only. IBM STAIRS is also useable).

5. Increasing computerization in government and commerce accentuates the lack of skilled personnel nationwide and there is a very real possibility that operators on achieving reasonable competence will be attracted elsewhere. While this in itself is not unreasonable, it can be disturbing to institutions which have funded initial training.

At all the regional and international centers visited, wherever there were computers (and they were generally used for statistical analysis, etc.), there were the same problems, varying only in degree.

TAIWAN - February 15-17, 1978

Due to a booking error, I arrived in unpleasantly cold weather and two hours later than planned at AVRDC, where I was greeted by the Director.

The following day, I met the Librarian, Mr. Huang, and his staff before working individually with researchers.

The library, while not fully developed, provides documentation on six specific vegetable crops. Our SDI service regularly scans for these topics, and printouts are filed for general use after selected entries are noted for addition to the document collection. Researchers may have individual profiles not necessarily limited to the six vegetable crops. All patrons are enthusiastic about the service, and the possibility of a charge for service was accepted in principle.

The Documentation section is interested in computerized bibliographic control of its collections, and there is some chance that this may be ultimately accomplished. An IBM computer was due to be installed within a month of my visit, and as staff member, Dr. Hubbell was formerly an IBM computer employee, there is every chance that the equipment will be functioning satisfactorily quite soon. However, the library is interested in having the existing mungbean bibliography of approximately 1800 items stored on tape, and this is a service we could provide on a contract basis.

THAILAND - February 17-25, 1978

Thai students at UH and visits by CTA staff to Thailand paved the way for service to five faculty members at Kasetsart University, the nation's center exclusively for agricultural education. Kasetsart has a student body of approximately 6000, of whom 1000 are graduates. The 3-floor library built in 1965 is bursting at the seams, the congestion being compounded by a huge delivery of new books purchased with a loan from the World Bank and now awaiting cataloging. A new campus (with library) is planned for 1979.

After meeting the Dean, I spent time with faculty in Entomology and Plant Pathology to develop about 20 profiles and amend existing ones. Later I briefly visited the small but well organized collection of the Fisheries Faculty and later that of the National Department of Agriculture Freshwater Fisheries, a very new collection in a new building. (The Librarian spoke almost NO English!) Since my baggage was "lost" for a week, time permitted visits to non-agricultural libraries including the Thai National Documentation Center, the Department of Science Library (one of the oldest, and very good) and the Siriraj Medical Center Library, which is very spacious, well organized and the nation's best in the health sciences. At a meeting which I addressed, there was occasion to evaluate informally the professional preparation and experience of more than a dozen library personnel.

AIT (Asian Institute for Technology) is a very new complex some 40+ kilometers from Bangkok. Besides its mission as a regional training center, the computer installation and the documentation center (AGE) interested me. An initial concentration on technology has now been expanded with the addition of another "division"--agricultural engineering and food technology (chairman Dr. Gajendra Singh). An impressive computing center houses IBM equipment (360?) under the direction of IBM staffers Drs. Kearns and Jordan. The facility is intended for training regional personnel, not as a service facility. It is, however, utilized by the AGE Documentation Center to organize their collection. According to the center's computer coordinator, a FORTRAN program used for storage makes for difficult retrieval and revision of the software is desired to meet library management and bibliographic needs. STAIRS (IBM) and ISIS are being contemplated.

INDIA - February 25-28, 1978

As the ICRISAT site is still being developed, units of the institute are dispersed in several city buildings and the rural location. The Library is

temporarily but very efficiently accommodated in a converted workshop until relocation into permanent quarters presently under construction. With dispersal of units, it is difficult for staff to use the facility, but this should change when all buildings are complete.

Besides a well organized general agricultural collection, a documentation centre, SMIC, concentrates on sorghum and millet. The total library staff of 17 persons would, by North American standards, be considered generous staffing. Five of this number are assigned exclusively to the documentation centre; two, having a knowledge of French, are responsible for indexing and abstract materials in that language. Several hundred items on both sorghum and millet have been identified; many have been acquired as preprint or photocopy for later document delivery. SMIC documents are controlled with the aid of TERMATREX, similar equipment being used in documentation centres in ILRAD, IITA and CIAT, all facilities receiving some measure of support from IDRC. There is at present no consideration of computer use in bibliographic control, although the ICRISAT computer manager expressed willingness to adapt his operations to Library use.

At a seminar well attended by reseachers, I outlined our services and as a result of this visit, the Documentation Centre has been added to SDI while retrospective searches have also been requested by individual staff. As the Documentation Centre is having difficulty acquiring photocopies of French language articles, a list of needed items was forwarded to UH for checking against our collection. While UH cannot provide the requested French version FAO document (we prefer English version), we would be able to provide at cost many requested items appearing in major French scientific journals. The Librarian was also specially interested in the bibliographies on legumes, prepared to support 2110.

The visit was additionally important as it afforded an opportunity to discuss with the Director, Dr. Swindale, the development of the project for the "International centre telecommunication network" linking the international centers and five selected U.S. universities including UH. In a recent trial ICRISAT (Hyderabad) was linked to the U.S.--at a cost of $100 for 24 minutes connect time. The role of UH-HITA in the proposed network was also discussed and Dr. Swindale indicated that support for the continuation of our present program would be a fitting topic for consideration at the next Directors' meeting at ILRAD, Nairobi in June.

KENYA - March 1-7, 1978

Our service was quite unknown in this nation now regarded as being the most advanced of the newly independent African nations, and therefore the preferred site for several major organizations including the United Nations Environmental Program (UNEP) and the East African Forestry Organization/East African Veterinary Research Organization (EAFRO/EAVRO), the Library of Congress East African Program, the Regional Center for FAO/AGRIS as well as ILRAD, ICIPE and the country center for ILCA. Deteriorating political stability in adjoining nations--Ethiopia, Somalia, Tanzania and Uganda--increases the importance of Kenya.

Target institutions were ILRAD and ICIPE, and as a result of my visit, both institutions are included in our service--ICIPE to individual researchers, ILRAD, the documentation center only. ILRAD is presently a-building, the library being one of the first units to move into new quarters. The collection is inadequate for the research staff of 25, and needs much upgrading to support the projected 80 researchers. The provision of a Documentation Center for trypanosomiasis and theileriosis has been contracted to Battelle, Genava, which assigns a documentalist to that location for 4 months yearly. To date 1000 on theileriosis have been fully indexed with 10,000 items on trypanosomiasis in author file only. Both files will be controlled with TERMATREX, although some limitations in this system are already apparent to the documentalist. In discussion with the Director, Dr. Henson, I pursued Dr. Swindale's suggestion that the future of our service be considered at the Director's meeting in Nairobi in June just before Dr. Henson leaves his post.

As the Director of ICIPE, Dr. Odiambo was an on an overseas visit, and I saw only the Librarian, who outlined the mission of that facility. Accommodation and organization of the library leave much room for improvement, which may come when ICIPE is accorded full international centre status. A documentalist is expected in June. I offered our services, and as a result nine ICIPE researchers were added to our SDI service.

While both ILRAD and ICIPE lack adequate library collections, that of EAFRO/EAVRO is remarkably good, with a comprehensive collection, including extensive journal backfiles, claimed to be the best agricultural resource in the nation, and therefore probably of East Africa. I visited this facility isolated several miles outside Nairobi at Muguga, and learned from the Library Director of this "contents page" Current Awareness Service to 60 units (reduced by the collapse of the East African Community from 143). He was very interested in the soil bibliographies prepared to support our 211D projects, and was invited to utilize our services.

The United Nations Environmental Program (UNEP) recently opened its headquarters in Nairobi. Included in its new low-rise, beautifully landscaped and environmentally-acceptable complex is not only a representative current collection of environmental interest, but also a computerized source directory, the core of its information referral service. Records of over 6000 entires are stored in a Geneva computer for online access, using TWIX telecommunications. This capability is the outstanding example in the African information scene of functioning automated service.

The Library of Congress East African Center is providing in conjunction with its collecting function for PL 480, the major contribution of bibliographic records for that part of Africa, having been responsible for recent lists of publications. An FAO/AGRIS regional center has not yet provided any input to Rome, according to the officer in charge. The library of the University of Nairobi at Kabete (Agriculture and Veterinary Medicine) supports the needs of 700 students and faculty of that unit as part of the University system and as such benefits from central processing and unlimited access to other University

collections. Of special interest is their sunflower bibliography, the core material being supplied by Netherland sources (PUDOC and RTI). Support documentation consists of photocopies and microfiche for which there is a reader but no printer.

In all, Kenya agricultural library resources are physically scattered and of varying worth. There seems room for both development of separate collections and cooperative sharing. Our institution could provide support services in computerized bibliographic access and possibly in document delivery.

There is neither a national library nor a national bibliographic center in Kenya. Moreover, there is no provision for professional education in librarianship or information science; previously a program was available for the East African community at the Makarere University, but this is no longer possible under the Amin administration.

NIGERIA - March 7-12, 1978

All my comments pertain to Ibadan, where apart from IITA, I was able to visit briefly the library of the University of Ibadan, which provides for a full range of disciplines. Considerable amounts of British money enabled the establishment of this collection which now shows signs of both continued use and insufficient maintenance. Its prime interest to me on this visit, was a possible support resource for IITA, just a short distance away.

Discussion at IITA were with the Director, Dr. Gamble, and to a greater extent with the Librarian, Mr. Steve Lawani. The collection includes significant French language titles, selected to meet the needs of the many French speaking participants attending regional training courses.

Apart from a reasonably good general agricultural collection (12,000 v. bookstock; 16,400 v. periodicals as well as other materials), a Documentation Center concentrates on grain legumes, cowpeas and farming systems. Again, as an IDRC supported unit, they utilized TERMATREX, and thesaurus adapted from Letherdale.

Areas of research interest common to both IITA and UH are tropical soils, edible aroids and other tropical tubers. Not only is there demand for UH bibliographies on taro, but also for soils and for sweet potato. Already the Documentation Center has requested both SDI and retrospective searches. Again, there is difficulty in document procurement, and a recent request for photocopies of 11 titles (edible aroids) could be supplied at cost from the UH collection.

Although there was no opportunity to meet research staff, a group discussion with six library professionals was appreciated, but another similar program planned for Ife University had to be cancelled on account of campus unrest. I did meet with the Director, Dr. Gamble, who was attentative and apparently sympathetic to UH-HITA plans. The IITA librarian who is professionally active and aware of current developments, indicated that a meeting of ICRISAT, IITA and CIAT documentation--library personnel was being planned and that my presence as a resource person would likely be sought. While this underscores an observed need for consultation services, it also affords an opportunity for closer coordination with the centers.

FAO/ROME - March 12-16, 1978

Originally a visit of only one day was planned; and this was duly filled, primarily in discussion with Mr. Thevenin, CARIS coordinator, Mrs. Allen, AGRIS coordinator and Bruce Webster, in the absence of Philippe Mahler, executive secretary for TAC. These discussions were important because they provided the "big picture" of plans for international provision and control of agricultural information, both published and current research. An added bonus was the impending international workshop on AGRIS-scope,

indexing policy, thesaurus, output both hardcopy and tape, and demonstration of AGRIS online. For many reasons, I was urged to delay departure for two days in order to attend the meetings as a member of the 5 member U.S. delegation. Intended primarily for Technical personnel, the workshop, attended by delegates from 60 countries or organizations, considered the present development of AGRIS, scope and selection for AGRINDEX, input format and indexing, output as hardcopy of machine retrieval and document delivery. At neither the FAO workshop nor on visits to the documentation centers was there readily available any firm quantitative statement of demand for documents. The Senegal delegation reported not one request for loans via AGLINET service. Documentalists at the international centers were vague about off-campus use of their collections. User statistics while not necessarily indicating the value of a collection, provide one measurement of fulfillment of purpose.

The workshop was a unique opportunity to learn of the needs of many subtropical/tropical countries, the problems of document delivery, the effectiveness of present policies, etc. and of course to view the special demonstrations. For many, the online demonstration of AGRIS was the first experience in computerized searching; for me, it was a unique opportunity to view the full file (3 year storage). Whereas early issues of AGRINDEX appeared to offer very little more than other indexing services, recent issues containing larger input from more contributing countries offer increasing coverage in tropical or subtropical agriculture. Although NAL, as National center, received to March 1978, 41 master tapes, none had been run, nor was there at that time any plan to search them. UH might want to consider arranging with NAL to search this file as a national service. It is now desirable that:

a. NAL fulfill its national obligation, or
b. Search capability be delegated to another center (possibly UH).

WASHINGTON - March 16-18, 1978

Extension of the Rome visit to include the AGRIS workshop permitted only one day (Friday, 17 March) in Washington. Moreover, in confirming onward flights, it was found that entry papers for Costa Rica were required before departure the next day. A meeting with Dr. Ralph Cummings had been requested before leaving Honolulu, but by mid-March he was travelling in Asia, and telephone efforts to set up an alternate meeting at the World Bank were not fruitful. Time after negotiating travel papers being exceedingly limited, there was no opportunity to visit National Agricultural Library at Beltsville; however, in telephone discussions with Dr. Hilary Burton, USDA/DSAD, I conveyed my observations especially on the development of AGRIS, and the desirability of searching the tapes. If NAL does not provide this service, this activity could be delegated possibly to University of Hawaii to serve the nation.

COLOMBIA - March 18-21, 1978

At CIAT, the only institution visited in this country, the information and documentation services are well established and productive. Documentation originally concentrated on the exhaustive collection of the literature of Cassava and provision of access in both Spanish and English; now, however, three other areas for selective collection have been added: Agricultural Economics in Latin America (Spanish language only); Bean (Phaseolus vulgaris), (Spanish and English); and Pastures and Forages in the Tropics (Spanish only),

The Cassava Centre with substantial IDRC funding produces monographs and extensive bibliographies (2 volumes, 4000 entries with abstracts) as well as a card service in both languages; the thesaurus was developed by Leatherdale of IDRC. The Pasture and Forage section, established with the help of Ford Foundation funds, is a newer enterprise; and to date only 60 or 70 documents have been processed, the thesaurus still being developed. The thesaurus for Bean documentation is a modification of that used for Cassava, while that for Agricultural Economics is a local modification of the OECD list. Storage/retrieval is by TERMATREX control and has been the model system for the documentation centres at IITA, ICRISAT, and ILRAD. Staff of the CIAT Documentation Centre (which utilizes the distribution facilities of the whole institution) totals 11 persons--coordinator, translator, bibliographer, secretary, 4 documentalists and 3 technicians. There is no immediate intention to computerize.

Failure to honor a flight reservation necessitated an unscheduled visit to the "city" to make alternative arrangements for pre-East travel, so that a meetin with the CIAT Director, Dr. Nickell, was not possible.

COSTA RICA - March 21-23, 1978

IICA/CIDIA, formerly on the grounds of Turrialba some distance from downtown San Jose, is now located in a modern facility nearer the city. I had hoped to visit the library at Turrialba, but as business was curtailed by local observance of Holy Week, both movement and accessibility were severely limited. However, IICA/CIDIA is the regional node for AGRIS input and is therefore responsible for bibliographic control of materials published in Central America; as such, it is a counterpart for SEARCA in the Philippines. Spanish is the operating language, and their output in monographs and bibliographies is impressive. Moreover, some computerization has been accomplished by contracting out to local business. The major criticism in computerizing bibliographies has been the need for extensive time-consuming editing by high-level professional staff, despite the fact that the customary AGRIS format sheet is used for organizing input information.

While IICA/CIDIA itself may have no direct need for our SDI services, the Turrialba unit would seem a potential user, and I regret circumstances prevented a personal visit. Prospects for the future of CATIE and Turrialba varied according to the source of information; personal reports from visiting faculty were much less optimistic than that from IICA, who were confident that

Costa Rican government support would ensure the restoration of Turrialba to its former level of excellence and world renown.

GENERAL OBSERVATIONS

In general, library and information services as we know them in North America simply do not exist in LDC's. Comprehensive well-organized collections, expanded with networking, interlibrary loan, translation services and computerized literature searching, all serviced by informed trained personnel are not realities in the Third World. Good progress, however, has been made primarily in facilities enjoying international financial support. Documentation centers aiming to collect, organize and provide materials on the specific crops and problems of the parent organization appear to be effective in that they assemble in-depth resources of "demand" information in what would otherwise be a desert. Apparently, funding for facilities, staff and equipment for these documentation centers is less a problem than is access to materials. Of the "international centers," all have access to computers utilized for germ plasma records, statistical data processing, fiscal management, etc. Library application of these computers is not planned, although in one case, computer personnel were interested in such utilization of the facility (ICRISAT). Agricultural Research Center (supported cooperatively by IRRI, UPLB, SEARCA and PCARR) Philippines, Asian Institute of Technology, Thailand, and IICA/CIDIA, Costa Rica are attempting machine storage and retrieval. Frequent interruptions in power supply, unsatisfactory software, lack of technical skill and uncertain supplies are continuing problems. IICA contracts out for storage; in all cases a common complaint is the time required for editing.

To a large extent lack of experience in bibliographic computerization along with oversupply of clerical assistance, excessive communication charges, and chronic power failures make rapid development of computerized bibliographic services a distant prospect. In a recent telecommunications experiment, to assess the feasibility of daily communication among 9 international centers and 5 U.S. agricultural institutions (of which UH is one) a successful link with Hyderabad (India) cost $240 per hour; charges for the Ibadan link were not available.

Current services, sought by centers:

1. Retrospective searches (charge service). Already AVRDC, ICRISAT and IITA have commissioned searches.

2. SDI; all major centers have requested service. While appreciating the current free service, they accepted in principle the prospect of charges to recover at least mailing costs and tape lease.

3. Access to inhouse computerized files, including those developed by our USAID 211D programs.

4. Opportunity to store on tape on contractual basis bibliographies developed at international centers, e.g., AVRDC.

Suggested Services to Regional or International Centers:

1. Channel for exchange of ideas, proposed information projects, etc.

2. Improved document delivery. This is a common and pressing need. A list of items required by ICRISAT is only one of 3 received within the past month; a research in rootcrops at UITA requires 11 articles on his topic, all of which we could provide; and one of our University faculty stationed on another island requires abstracts to supplement approximately 80 citations retrieved on a computerized retrospective search. At the moment, this project is not set up to handle this type of request. As an experiment, a list of French language journal articles required by ICRISAT Documentation Centre has been checked against our UH holdings. Essentially the list is of 3 sections:

   a. FAO French language publications - UH prefers the English language version, so we cannot meet this need.
   b. French language journals in UH. These include Sols Africains, Revue de Botanique Appliquee et d'Agriculture Tropicale, Agrochimica (Italie), Comptes Rendu de l'Academie des Sciences, Annales de Technologie Agricole, Annales de Phytopathologie, etc.
   c. French language journals not in UH. These are primarily earlier publications, many of the French colonial regime, in Senegal, Morocco, Algeria.

   Purpose of this scan was two fold:

   a. To determine UH capacity to provide items requested by Centers. This provision would reduce both their dependence on NAL and criticism of slow service (at the AGRIS meeting, the Brazil delegate complained of 6 month waiting time for response to AGLINET requests for NAL).
   b. To identify strengths and gaps in the UH collection.

RECOMMENDATIONS

1. That services to the state and overseas agricultural interest be continued, with special cooperation with the international centers in order to contribute effectively to their international communication network.

2. That funding be procured for continuation of Project 172 in an expanded service mode. Suggested funding arrangements:

   a. Cost of tape lease, postage and supplies be defrayed by revenue from changes for contractual services - SDI service, machine storage of bibliographies of international centers and retrospective searches.

b. Salaries and computer center costs be borne by UH/CTA. Assistance, possibly as a contributing grant may be requested later from CGIAR institutions.

3. That NAL be urged to mount the AGRIS tapes, and failing this, that the possibility of incorporating AGRIS in UH SDI services be explored.

4. That tape leases be negotiated for CAB and BAT, both of which have only recently become available.

5. That document delivery to international centers be provided on a charge basis, with due observance of copyright requirements.

Respectfully submitted,

(Mrs.) Barbara K. Bird
Assistant Researcher

cc: N. P. Kefford
K. T. Otagaki
K. Bridges

211(d) Institutional Grant
Project Design Summary

Project Title: Mineralogy and Microbiology of Tropical Soils

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	REPORTING YEAR ACHIEVEMENT	FUTURE PLANS, REMARKS
Outputs: G. Uehara Output No. IV. Advisory Capacity Provide advising and consulting services to LDCs, AID and other donors committed to improving conditions of small farmers, and provide release time to enable faculty to achieve grant purposes and respond expeditiously to AID requests for assistance.	1. Approximately 10 full-time, tenured staff available for problem identification and analysis, project design, education and training and resource evaluation and planning relating to management of tropical soils in LDCs in emergency situations.	1. College reorganization underway to render all faculty more responsive to local and international small farmer needs.	1. Reorganization expected to be completed within the year with assurance of strong commitment to international agriculture and human resources development.
	2. Two full-time positions filled to release tenured faculty to achieve grant purposes.	2. Visiting Lecturer (Dr. J. Ellis) hired to enable faculty to spend more time on grant objectives.	
	3. Faculty visits to AID to be updated on agency priorities.	3. College administrators in constant contact with AID to develop long term involvement in international agriculture.	
	4. Grant funds allocated to enable faculty to respond quickly to Agency request for assistance.	4. (1) Bangladesh trip completed; (2) Djibouti trip accepted.	

involved in expanding the information capacity of the University. Mrs. Bird's assessment of the information capacity of developing countries provides a sound basis for future effort in this area. Although Mrs. Bird's activities clearly fall under the grant objectives, her work is supported by another University program.

E. Linkages and Networks (Grant Project Director)

In conjunction with sister Consortium universities and two Hawaii international projects (Benchmark Soils and NifTAL projects), the grantee institution has developed a linked tropical soils network in Southeast Asia, Latin America and Africa. Consortium activities and findings are publicized through a newsletter. The grantee institution alone distributes 100 newsletters to agencies and scientists in Southeast Asia. Latin America and Africa are accommodated by sister universities.

New Zealand will host an international soil science conference in 1981. The theme of this conference is "Variable Charge Soils and Technology Transfer". The conference topics were selected in consultation with the grantee instutution.

Administrators and scientists from the Soil Conservation Service of the U.S. Department of Agriculture and FAO, Rome are working jointly with the Consortium universities to upgrade the U.S. soil classification system for application in the tropics.

VII. Other Resources for Grant-Related Activities

Grant activities have influenced the research and development strategy of developing and developed nations and international agencies. The resources of the U.S. Soil Conservation Service, U.N. Food and Agricultural Organization, operating independently in the past, have been mobilized into a team effort by

211(d) Institutional Grant
Project Design Summary

Project Title: Mineralogy and Microbiology of Tropical Soils

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	REPORTING YEAR ACHIEVEMENT	FUTURE PLANS, REMARKS
Outputs: G. Uehara			
Output No. V. Networks and Linkages Facilitate utilization and development of U.H. response capability through timely exploitation of linkage opportunities with international and national groups committed to assisting the small farmer of developing countries.	1. Progress reports on SOTA contributed at COST meetings.	1. SOTA on mycorrhiza completed, 2 BNF coordination meeting attended. Contribution to CST Newsletter.	1. Strong indication that linkages will be maintained and strengthened even after grant expiration.
	2. Divert faculty sabbatic leaves from U.S. institutions to organizations committed to assisting LDCs.	2. One faculty member committed to spend sabbatic in middle east.	2. Continued support including non-AID sources will be sought.
	3. Send key SOTA personnel to seminars, workshops and conferences sponsored by AID and other donor agencies which contribute substantially to achievement of grant purpose.	3. Two faculty members attend international workshop on Low Activity Clays in Brazil. One attends Land Evaluation workshop in FAO, Rome.	
	4. Encourage and support visits to Hawaii of scientists, LDC decision makers, AID Bureau and mission personnel to advise U.H. on ways to facilitate linkages.	4. Strong support from college administration to encourage visit by LDC and international groups committed to development support.	

the Consortium of Soils of the Tropics to work towards a common goal of improving a standard soil classification system for use in the tropics. This is an unprecedented achievement. Joint and closely coordinated planning by the AID sponsoring office and the Consortium universities make this possible. The involvement of developing country agencies has been a key factor in the planning of this activity. The resources of developing countries will undoubtedly be channeled to achieve common goals. Those countries which show signs of using a standard soil classification system (U.S. system) are Indonesia, Philippines, Malaysia, Thailand, Sri Lanka, Brazil, Colombia, Venezuela, and Costa Rica.

New Zealand has committed its Soil Bureau to use the U.S. system and will promote this new system in the Pacific Islands.

Both developing and developed countries are prepared to invest in a standard system of soil classification because they realize the importance of such a system for information exchange and technology transfer. The returns on this investment will far exceed the Consortium contributions.

Table 2. Expenditure report, actual and projected (review period July 1, 1977 to June 30, 1978)

	Previous Year	Actual Period Under Review	Projected
Salaries & Wages (Total)	$51,607.67	120,782.86	156,000.00
Salaries	41,202.21	100,543.11	
Fringe	6,343.02	17,568.20	
Student Help	4,062.44	10,671.55	
Supplies (Total)	3,618.40	22,520.49	30,000.00
Supplies & Publications	3,065.55	21,001.16	
Library Acquisitions	552.85	547.33	
Equipment (Total)	1,162.62	197.60	765.36
Travel (Total)	15,274.19	40,062.31	50,000.00
Inter-island	1,007.55	1,159.20	
Out-of-State (U.S.)	2,327.20	11,534.44	
Foreign	11,939.44	27,368.67	
TOTAL	$71,662.88	191,571.26	236,765.36