

AGENCY FOR INTERNATIONAL DEVELOPMENT WASHINGTON, D. C. 20523 BIBLIOGRAPHIC INPUT SHEET	FOR AID USE ONLY <i>Batch #16</i>
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1. SUBJECT CLASSIFICATION	A. PRIMARY	Serials	Y-AF20-0000-GG50
	B. SECONDARY	Agriculture--Soil science--Tropics	

2. TITLE AND SUBTITLE
 Tropical soils, annual report for the period ending August 31, 1971

3. AUTHOR(S)
 (101) Univ. Consortium on Soils of the Tropics

4. DOCUMENT DATE 1971	5. NUMBER OF PAGES 110p.	6. ARC NUMBER ARC 631.4.U58
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7. REFERENCE ORGANIZATION NAME AND ADDRESS
 UCST

8. SUPPLEMENTARY NOTES (*Sponsoring Organization, Publishers, Availability*)
 (Adm. summary)

9. ABSTRACT

10. CONTROL NUMBER PN-RAA-892	11. PRICE OF DOCUMENT
12. DESCRIPTORS Tropics	13. PROJECT NUMBER
	14. CONTRACT NUMBER UCST
	15. TYPE OF DOCUMENT

Annual Report

FOR THE PERIOD ENDING AUGUST 31, 1971

UNIVERSITY CONSORTIUM ON SOILS OF THE TROPICS

**The Consortium consists of Cornell University, The University of Hawaii,
North Carolina State University, Prairie View A and M College, and the
University of Puerto Rico.**

ANNUAL REPORT

For the Period Ending August 31, 1971

UNIVERSITY CONSORTIUM ON SOILS OF THE TROPICS

The Consortium consists of Cornell University, the University of Hawaii, North Carolina State University, Prairie View A and M College, and the University of Puerto Rico.

FOREWORD

This is the first annual report of the University Consortium on Soils of the Tropics to the United States Agency for International Development. The report summarizes accomplishments under grants provided to the five member institutions through the Institutional Grants Program established by Section 211(d) of the Foreign Assistance Act of 1961 as amended in 1966.

The grants, which were made to enhance the competencies of the recipient universities for teaching, research, and service in the subject matter of tropical soils, became effective at different times. The grant numbers and implementation dates are: (a) Cornell University (Grant AID/csd 2834) on June 30, 1970; (b) The University of Hawaii (Grant AID/csd 2833) on November 2, 1970; (c) Prairie View A and M College (Grant AID/csd 2836) on June 30, 1970; (d) North Carolina State University (Grant AID/csd 2835) on November 2, 1970; and (e) The University of Puerto Rico (Grant AID/csd 2857) on March 4, 1971. Consequently, the periods covered by this report differ correspondingly among the five institutions, but the end of the reporting period is August 31, 1971, for all.

The report consists of six parts, identified by page numbers prefixed by letters A through F. Part A presents the accomplishments for the reporting period and plans for the coming year for the Consortium as a unit. Parts B through F are the detailed reports of the five participating institutions. Each part includes a report of activities for the reporting period and a plan of work for the 1971-1972 operational year. Each of the individual institutional reports

also includes a statement of expenditures under the grant for the fiscal year within which that institution has operated and a projection of expenditures for the next fiscal year. The fiscal years of the various institutions are for different periods, and do not coincide with the operational year for which activities are reported.

TABLE OF CONTENTS

Foreword	i
Summary	A-1
The Consortium Program	A-3
Introduction	A-3
Accomplishments to August 31, 1971	A-5
Teaching	A-6
Research	A-7
Service and Consultation	A-9
Involvement of Other University Resources	A-11
Plan of Work for 1971-72	A-12
Joint Activities	A-12
Teaching and Research	A-14
Service and Consultation	A-16
Report of Cornell University	B-1
Summary.....	B-1
Goals	B-3
Major Accomplishments	B-3
Plan of Work for 1971-1972	B-8
Expenditures	B-12
Budget for 1971-1972	B-12
Report of the University of Hawaii	C-1
Summary of Accomplishment and Plan of Work	C-1
Goals	C-3
Major Accomplishments	C-4

Plan of Work for 1971-1972	C-12
Expenditures	C-17
Budget for 1971-1972	C-19
Report of Prairie View A and A College	D-1
Summary of Contributions	D-1
Goals	D-2
Major Accomplishments	D-6
Plan of Work for 1971-1972	D-22
Expenditures 1970-1971	D-27
Budget 1971-1972	D-29
Report of North Carolina State University	E-1
Summary of Contributions	E-1
Goals	E-1
Major Accomplishments	E-3
Plan of Work for 1971-1972	E-10
Expenditures 1970-1971	E-12
Budget 1971-1972	E-20
Report of the University of Puerto Rico	F-1
Summary of Contributions	F-1
Objectives	F-3
Major Accomplishments	F-3
Plan of Work for 1971-1972	F-8
Expenditures 1970-1971	F-8
Budget 1971-1972	F-10

SUMMARY

This first annual report of the University Consortium on Soils of the Tropics describes accomplishments and plans under a joint project financed by grants from AID for enhancing the competencies of the five member institutions for teaching, research, service, and consultation on soils of the tropics and their use for food and fiber production.

During 1970-1971, eight new courses on tropical soils have been initiated and five and one-half full-time professorial staff equivalents have been added to staffs of the member institutions. Ten graduate assistants, two post-doctoral fellows, and one technician have been supported by 211(d) funds. One long-term and eleven short-term visiting professors and scientists have consulted and lectured at the institutions during the reporting period. By the end of the 1971-1972 operational year, the cumulative numbers of new and revised courses and new participating personnel are expected to be: Fifteen new courses, twelve revised courses, eight new full-time professorial staff equivalents, two post-doctoral fellows, twenty graduate assistants, three long-term and twenty-five short-term visiting professors and scientists, and one exchange professor. A "Work Shop on Teaching Basic Soils" with particular reference to the tropics was held for teachers of the Consortium institutions. These actions have affected instruction not only through the initiation of new courses and new teaching techniques but also through enlarged perspective of the teachers of established courses. These trends are expected to continue.

Funds of the 211(d) grants have been used to stimulate participation of staff and graduate students in research projects

supported mainly by other funds. For the two institutions located in the tropics, 211(d) funds have been used to augment resources for their continuing research programs. North Carolina State University and Cornell have supported activities that contribute to their related programs under AID research contracts. At Prairie View A and M College, 211(d) funding has stimulated establishment of four research projects. At the University of Puerto Rico, additions of new staff have released other staff from teaching, permitting all staff to participate in research. These accomplishments are expected to be expanded.

Seven staff members of the Consortium have participated in one or more major consulting and service assignments as well as in many activities with foreign visitors and other scientists from the tropics. At least eight service and consulting assignments are projected for 1971-1972. Activities of the program have stimulated major inputs into the program by staff supported by other funds. Other major institutional inputs are described.

THE CONSORTIUM PROGRAM

Introduction

The University Consortium on Soils of the Tropics is an association of five educational institutions. The institutions have joined in a cooperative program to strengthen and coordinate their competencies and resources in soil science for teaching, research, technical assistance, and consultation for increasing food and fiber production on soils of the tropics. The joint program has been designed to enhance the capacity of the United States to provide technical assistance to developing nations.

Each of the member institutions has had commitments to programs for agricultural development in the tropics and had existing competencies in soil science for the tropics when the program was initiated. The Agency for International Development is supporting the program to strengthen and coordinate existing institutional competencies and resources through grants to the member institutions under authority of Section 211(d) of the Foreign Assistance Act of 1961 as amended in 1966.

Each member institution has defined a field of concentration that is emphasized in the use of grant funds, as follows:

- Cornell University-----Cultural systems for
soils of the tropics.
- University of Hawaii-----Biology and mineralogy
of soils of the tropics.

North Carolina State University-----Soil fertility relating
plant nutrition to the
physical and chemical
properties of soils of
the tropics.

Prairie View A and M College-----Soil fertility problems
under savanna - prairie
ecology.

University of Puerto Rico-----Conservation and protection
of soils of the tropics.

The fields of concentration are interrelated. Each is designed to augment or complement existing competencies of the institution. Collectively, the fields of concentration and existing competencies of the five institutions provide a range of complementary specialties representing the major facets of soil science for United States competence in soils of the humid tropics. Another consortium specializes in water management for soils of the arid and subhumid tropics.

To implement the joint program, the Consortium plan, with AID support, provides for: (a) a council of institutional representatives having administrative authority for policy and for program guidance; (b) an executive committee of institutional project leaders to develop and implement detailed plans of operation and cooperation; (c) additional resident and visiting professional staff to reinforce and complement existing competencies; (d) support of graduate students and faculty for development of competencies and resources, including (1) personnel exchanges to capitalize on the respective strengths of the cooperating

institutions, (2) assignments of personnel to tropical areas for experience, and (3) joint cooperative activities for special services; and (e) increasing institutional material resources and supporting staff, including library facilities, technicians, and stenographic service.

The cooperating institutions provide administrative services, existing physical resources, and inputs from existing faculty competent in the field. Each is committed to development of viable teaching and research programs on soils of the tropics and to accommodate requests for training, technical assistance, and consulting services as feasible and consistent with institutional resources and continuing domestic commitments.

Accomplishments to August 31, 1971

The accomplishments that are a direct result of AID support are summarized here under the headings: (a) Teaching; (b) Research; (c) Service and Consultation; and (d) Involvement of Other Institutional Resources. These areas of activity are treated here in the perspective of the Consortium as a whole, including both contributing activities of individual institutions and joint projects. Accomplishments of the individual institutions are described in detail in sections that follow.

The periods during which AID support has been available prior to September 1, 1971, ranges from 14 months for Cornell University and Prairie View A and M College to six months for the University of Puerto Rico. AID support has been available to North Carolina State University and the University of Hawaii for 10 months.

Teaching

Nine teachers of basic soils courses, representing all of the cooperating institutions, participated in a highly productive two-week workshop on soils instruction with special reference to the tropics under the auspices of the University of Hawaii. Participants studied tropical soils and crop production in the field and discussed subject matter of basic soils courses and teaching techniques in depth. The workshop was especially valuable to teachers of institutions in temperate climates.

The five institutions, collectively, initiated eight new soils courses oriented to tropical environments, as follows: Cornell - one; Hawaii - two; Prairie View - three; and Puerto Rico - two. The institutions added six new professorial staff members whose duties include teaching various subject matter areas of soils of the tropics: Cornell - one, half-time; North Carolina - one, full-time; Prairie View - two, full-time; and Puerto Rico - two, full-time. Ten graduate assistants were supported by 211(d) funding for part or all of the period: Cornell - two; North Carolina - two; Prairie View - five; and Puerto Rico - one. The graduate assistants have served the project in a variety of ways, including teaching, library work, and research on tropical soils.

Twelve visiting professors and scientists were brought to the several institutions with support from the 211(d) grants. Their services included presentation of seminars and lectures and consultation with resident teachers on subject matter relevant to tropical soils and on teaching techniques. Seven of these scientists came with extensive experience in the tropics. They have made important impacts on resident

staff as well as on students. Cornell had two short-term consultants; Hawaii, one long-term and one short-term consultant; Prairie View, six short-term consultants; and Puerto Rico, two short-term consultants. (Long-term consultants serve for an academic quarter or semester or longer; short-term consultants, for lesser periods.)

The University of Hawaii, the University of Puerto Rico, and Prairie View A and M College have begun to develop audiovisual teaching techniques for soils courses, partly or wholly from financing by the grants. Prairie View is developing an autotutorial system for a "Tropical Soils Resource and Enrichment Center" that will service both undergraduate and graduate students. One of the consultants who served Prairie View was brought to the campus on 211(d) funds to advise on its development.

The University of Hawaii is developing teaching materials illustrating important concepts of soil science on single sheets, some in color. These are available to the Consortium and can be translated into foreign languages.

All of the cooperating institutions have begun an inventory of library resources for tropical soils and a program of acquisitions. Three institutions have developed printed brochures describing the tropical soils program. Three of the institutions have provided members of the Consortium with college or university "announcements" or "catalogs."

Research

The cooperating institutions have used funds from the 211(d) grants to stimulate new research or to augment research under way

on other funds. The grants have not been used as the sole source of support for independent research projects on the grounds that institution building for continuing research programs can be accomplished best within the framework of broadly based financial support.

The soil research programs of the Universities of Hawaii and Puerto Rico are wholly oriented to tropical conditions. During the 10 months that 211(d) funds have been available to the University of Hawaii, expenditures from that source for research have been small and primarily for supplies, minor equipment, and travel in support of professional staff who work in the area of mineralogy of tropical soils, which is the institution's field of concentration for the 211(d) program. Two post-doctoral fellows and one technician added by the University of Hawaii will have major research responsibilities.

The impact of 211(d) funding on research at the University of Puerto Rico has been large. The two professors and one graduate assistant added during 1970-1971 have major responsibilities for research. More importantly, however, their presence has permitted the teaching load to be distributed among more of the staff, releasing time for research. Where a high proportion of the staff in soil science formerly could not participate in research, all now have a research component among their duties. This is a highly significant factor, not only for the research program but also for the quality of teaching.

At Prairie View A and M College also, 211(d) funding has had a major impact on research. Both of the two staff members added have research responsibilities. All of the five new graduate assistants listed in the section on teaching also work on research projects.

As a direct result of these new manpower resources, four new research projects financed mainly from other sources have been initiated.

North Carolina State University and Cornell University have research programs in tropical soils financed mainly by separate AID research contracts. The two research programs are interrelated, and the two institutions coordinate their activities. North Carolina State University concentrates its field research in various countries of South and Central America. Cornell subcontracts with the University of Puerto Rico for personnel and services and operates from a Puerto Rico base, with satellite operations planned for South America. Independently financed field research is also under way by Cornell in Colombia. The three institutions, Cornell, North Carolina State University, and the University of Puerto Rico are, in fact, an informally associated research group. The primary research of Cornell and North Carolina State Universities on tropical soils is organized within this framework. Some 211(d) funds are used to augment that effort. During 1970-1971, Cornell used 211(d) funding to support one graduate assistant in the program, to provide staff travel to sites of research in tropical areas, and for minor items of supplies and services related to their work. North Carolina State University used 211(d) funds to support two graduate assistants on research and for minor travel, supplies, and services.

Service and Consultation

Most of the service and consulting activities listed below were financed by funds other than the 211(d) grants, but are intimately

related to objectives of the Consortium. Those supported in part or wholly by 211(d) funds are identified.

Professor Drosdoff of Cornell chaired the Committee on Tropical Soils of the National Research Council under a special AID contract. He is responsible for the report, which is currently being edited for publication.

Professors Sanchez and McCants of North Carolina and Professor Alexander of Cornell participated in a colloquium on soil nitrogen sponsored by the Colombian Society of Soil Science. They also consulted with CIAT and ICA.

Professors Sanchez and Buol of North Carolina consulted in Peru on matters pertaining to the establishment of a research station to study management of soils under shifting cultivation.

Professors Bouldin and Drosdoff of Cornell with 211(d) support and Professor Kamprath of North Carolina on funds from the AID research contract consulted with the Brazilian Director of Research and the AID Mission on development of a tropical soil research project in Brazil.

Professor Uehara of Hawaii consulted with the Thai Regional Economic Development Office and participated in a conference sponsored by them.

Professor Sanford of Hawaii consulted with French authorities on soil and related problems of French West Africa.

Dr. J. Kirkwood of Prairie View cooperated with staff of Texas A and M University in development of a research program on soil fertility in savanna areas of the Dominican Republic.

The University of Puerto Rico with partial support from the 211(d) grant provided soil analyses for the Soil Conservation Service in Puerto Rico.

Other linkages include those provided by numerous visitors and various kinds of foreign contacts. A very large number of scientists, as well as others, visit the University of Hawaii; between 15 and 25 visitors from tropical areas visit North Carolina State University and Cornell each year. Both North Carolina State and Cornell Universities have ties with foreign scientists through their research operations and graduate programs. North Carolina has active contacts in 10 South and Central American countries; Cornell works formally in two. The University of Hawaii provides joint appointments of staff in soil science with the East-West Center Food Institute. The Universities of Hawaii and Puerto Rico are collaborating on a South-East (U.S.A.) regional research project.

Involvement of Other University Resources

Many of the Universities' contributions to the tropical soil programs as a consequence of the 211(d) grants are difficult to identify in quantitative terms. Increased sensitivity of staff to phenomena of tropical environments and the impact of broadened perspective on teaching are difficult to measure. Nevertheless, the impact is large, is apparent, and is highly significant. At one of the temperate zone institutions, for example, five professors supported by State funds devote 10 to 20 percent of their time to research and teaching on tropical soils, and five others contribute significantly. Teaching of most of the staff has been broadened to include greater emphasis on soils of the tropics.

Among the more tangible effects, the following are examples:

- (a) State financed equipment at the University of Hawaii,

valued at about \$100,000, was purchased as an outgrowth of the 211(d) grant;

- (b) Greenhouses at Prairie View A and M College, valued at \$120,000, have been approved for construction as a consequence of activities supported by the 211(d) grant. The construction of a second soils laboratory and requisitioning of equipment for work on tropical soils are underway.

At the University of Hawaii, a consultant on audiovisual and autotutorial systems was brought to the campus on other funds for development of teaching techniques.

Plan of Work for 1971-1972

Joint Activities

Executive Committee meetings are planned to expand the linkages among institutions of the Consortium and between them and institutions located in the tropics. The 1971 fall meeting, where this report was outlined, was held in Hawaii and included field trips to study soils and farming on three islands of the State. The 1972 spring meeting is planned for Ibadan, Nigeria, at the International Institute of Tropical Agriculture in conjunction with a conference of African soil scientists and others on research problems of soils of the tropics, which will be sponsored by IITA.

An institute for professional soil scientists, both U.S. and international, holding B.S. or higher degrees is being planned for July and August, 1972, in Puerto Rico. The objective is to provide intensive

instruction in the applications of current knowledge of soil science and related disciplines to problems of crop production in the tropics. The institute is being developed as a service to soil scientists who cannot, for one reason or another, maintain necessary contacts with the advancements of soil science.

Plans are being developed to hold a sequel to the 1970-1971 soils teaching workshop. It would be held in Puerto Rico with field work both there and possibly in the Dominican Republic to expand the experience and concepts of participants of the Hawaii workshop.

Plans are developing jointly between Cornell and North Carolina State University to establish an extension of their research on tropical soils to Brazil. Although major support would come from research project funds, 211(d) financing would contribute through support of some activities of staff and graduate research assistants.

Plans have been made jointly by the Universities of Hawaii and Puerto Rico to correlate the classifications of Hawaiian and Puerto Rican soils and relate them to the systems of both FAO and the U.S. National Cooperative Soil Survey.

Existing systems for cataloging and retrieving information about available literature will be investigated. The Executive Committee has concluded that a system that would establish and maintain a comprehensive survey of the literature on soils of the tropics is beyond the capabilities of the Consortium. Systems of existing bibliographical services, such as those of the National Agricultural Library and of TVA, will be investigated to determine their potential uses and the possibility of collaboration to provide special service to the Consortium.

The collaborating institutions will begin to assemble information about research and teaching institutions in the tropics, their personnel, and their programs. The intent is to assemble such information in a standard format for ready reference not only for members of the Consortium but for others as well.

Teaching and Research

Table 1, which follows, summarizes the new personnel and course offerings provided by 211(d) grants for 1970-1971, those planned for 1971-1972, and the cumulative totals expected by August 31, 1972. Most of the personnel indicated serve both research and teaching. (See Page A-15).

Incorporation of subject matter relevant to tropical soils will continue in established courses as staff members are exposed to activities of the program and related research. Research contributions will continue to be made mainly through existing projects supported primarily from other sources. It is anticipated that during 1971-1972, the following personnel, among those listed in Table 1, will have major research responsibilities under 211(d) funds:

Cornell University	Two graduate assistants
University of Hawaii	One professor Two post-doctoral fellows Two graduate assistants One technician
North Carolina State University	One professor Four graduate assistants
Prairie View A and M College	Two professors Five graduate assistants

University of Puerto Rico

Three professors
One graduate assistant

These include personnel added in 1970-1971 and planned for addition during 1971-1972.

Table 1. New and revised courses and new personnel added in 1970-1971 and planned for 1971-1972 at the five cooperating institutions.

	Cornell	Hawaii	North Carolina	Prairie View	Puerto Rico
<u>New Courses</u>					
1970-1971	1	2	0	3	2
1971-1972	<u>1</u>	<u>1</u>	<u>1</u>	<u>3</u>	<u>1</u>
Total	2	3	1	6	3
<u>Courses Revised (1970-1972)</u>					
	1	1	5	3	2
<u>Professorial Staff (Man equivalents)</u>					
1970-1971	1/2	0	1	2	2
1971-1972	<u>1/2</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>1</u>
Total	1	1	1	2	3
<u>Post Doctoral Staff (1970-1971)</u>					
	0	2	0	0	0
<u>Technicians (1970-1971)</u>					
	0	1	0	0	0
<u>Graduate Assistants</u>					
1970-1971	2	0	2	5	1
1971-1972	<u>3</u>	<u>2</u>	<u>2</u>	<u>0</u>	<u>3</u>
Total	5	2	4	5	4
<u>Visiting Professors and Scientists</u>					
Long term					
1970-1971	0	1	0	0	0
1971-1972	<u>1</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>0</u>
Total	1	1	0	1	0
Short term					
1970-1971	2	1	0	6	2
1971-1972	<u>4</u>	<u>1</u>	<u>2</u>	<u>5</u>	<u>2</u>
Total	6	2	2	11	4
<u>Exchange Professors (within Consortium)</u>					
Going					
1971-1972	0	1	0	0	0
Coming					
1971-1972	1	0	0	0	*

* One shared with Cornell for a short period.

Service and Consultation

Activities in this category are likely to develop on relatively short notice. At this time, the following are anticipated:

Cornell University-----Establishment of a research project
in Brazil.

University of Hawaii----- (1) Consulting and service on silting
and water management in the Mekong delta.
(2) Participation in a conference on
sulfate soils. (Netherlands)

North Carolina State
University-----Initiation of research in Guatamala,
Peru, and Brazil; consultation in
Colombia, Peru, Brazil, and Central
American countries.

Prairie View A and M College--(1) Consultation for training of
Peace Corps volunteers for service
in Niger and Upper Volta, Africa.
(2) Inputs to research in the savanna
of the Dominican Republic, with
Texas A and M.
(3) Consultation with Njala Uni-
versity College (Sierra Leone).

University of Puerto Rico----Participation in an FAO seminar on
Latin America (Mexico).

Funding from 211(d) sources will support part, but not all, of the costs of the activities listed.

REPORT OF

CORNELL UNIVERSITY

REPORT OF CORNELL UNIVERSITY

Grant AID/csd 2834

Summary

The introductory soils course now includes more material on tropical soils as a result of the professors in charge participating in a teaching workshop and research activities in a tropical environment. A course was initiated on clay mineralogy with special reference to the tropics. Two graduate students were supported by the grant for duties related to tropical soils. Three new graduate students have been awarded assistantships under the grant for 1971-1972. Two short-term visiting scientists have lectured and consulted with staff and students on soils and agriculture of the tropics. Arrangements have been made for several distinguished Visiting Professors and Scientists to lecture and consult on tropical soils during the next two years. Preliminary plans were developed for a Tropical Soils Institute in 1972. Research on tropical soils problems largely financed by other funding has been augmented by the grant support for graduate assistantships and staff travel to research sites in tropical areas. A significant impact has been made on the teaching, research, and advisory services in tropical soils of staff supported by State and other funds outside of the grant.

The plan of work for 1971-1972 will emphasize: (1) establishing local funding for a position of Professor of Tropical Soils to insure continuation of the program beyond the end of the current 211(d) grant; (2) developing research and instruction on system of culture for crop production on tropical soils; (3) developing the tropical soil component

of resident instruction; (4) developing collaboration and interaction with other institutions both in the United States and abroad, for mutual effectiveness in teaching, research, and consultation on tropical soils and their use.

Goals

The purpose of this grant, which became effective on June 30, 1970, is to strengthen the existing competency of the New York State College of Agriculture at Cornell University in a collaborative effort with the University of Hawaii, North Carolina State University, Prairie View A and M College, and the University of Puerto Rico, to provide training, related research, technical assistance and consultation in soil science for increasing food production on tropical soils. The main area of concentration of Cornell University in this collaborative effort is to develop instruction and research on practical cultural systems for tropical soils consistent with the biological, economic, and social environments of developing nations.

Major Accomplishments

Teaching.

1. With support from the grant an Assistant Professor, Dr. R. M. Weaver, has been added to the staff to develop a course on clay mineralogy with special reference to soils of the tropics. During the past year, Dr. Weaver has also been supported by other funds for research on the characterization of clay minerals in soils of the humid tropics to provide a basis for the interpretation of the availability of plant nutrients to crops grown in the field. Most soils of the humid tropics are characterized by the high content of iron and aluminum hydrous oxides and the predominance of kaolinite and amorphous material in the clay fraction. These characteristics plus the high temperature and rainfall conditions have a profound influence on the soil management practices, especially the amount, rate,

and method of application of fertilizers used with different crops.

2. The introductory course in Soils is given by Professors Lathwell and Scott who have been interested in introducing more material on tropical soils in their teaching. Over 200 students enroll in the course during the year and the students range from sophomores to graduate students. The grant provided an opportunity for Professor Scott to spend a week in Puerto Rico to become familiar with tropical soils, and in July he attended the two weeks tropical soils workshop in Hawaii with colleagues from the four other universities in the Consortium to exchange ideas and broaden their understanding of the properties and management of tropical soils. Mr. Gordon MacCaskill, who assists Professors Lathwell and Scott in teaching the introductory course in Soils, also attended the workshop.

Professor Lathwell spent his Sabbatic leave in 1970-1971 in Puerto Rico, supported by other funds, doing soil fertility research and became familiar with many of the problems in the management of tropical soils. As a result of his experience there and the experiences of Professor Scott and Mr. MacCaskill at the tropical soils workshop, the introductory soils course will now include more material on tropical soils, which should broaden the perspectives of the students.

3. F. Jurion served as Visiting Professor in the Department of Agronomy for about three weeks in March, 1971. Mr. Jurion was Director of the Belgian Agricultural Research Institute in the Congo (I.N.E.A.C.) for over 25 years. The I.N.E.A.C. with its main station at Yangambi and over 40 substations located throughout the Congo has probably contributed more to our knowledge of tropical agriculture than any other institution. The leadership of Mr. Jurion in organizing and directing this program

was largely responsible for its outstanding contributions. The work of the I.N.E.A.C. has recently been compiled and summarized in a major publication by Mr. Jurion and Mr. Henry entitled, "Can Primitive Farming Be Modernized?"

During his stay at Cornell, Mr. Jurion gave eight illustrated lectures on tropical soils, crops, animal science, and agricultural development. He gave seven seminars on various aspects of tropical agriculture and consulted with staff and students in the Department of Agronomy.

4. Dr. Charles E. Kellogg, Deputy Administrator for Soil Survey of the USDA Soil Conservation Service was a Visiting Scientist for three days in March, 1971. He gave lectures on tropical soils to four different classes, presented two seminars, and consulted with many of the staff and graduate students on various aspects of tropical soils.

5. Preliminary arrangements have been made for several distinguished Visiting Professors and Scientists to be on the Cornell campus during the coming year. Their identity and the plans for their activities are given in a subsequent section of this report on the Plan of Work for Next Year.

6. Preliminary plans have been made for a four week Tropical Soils Institute to be held in Puerto Rico in the summer of 1972. The details of this program as well as other courses being planned are given in a subsequent section of this report on the Plan of Work for 1971-1972.

Research.

1. A research project in cooperation with the University of Puerto Rico and in collaboration with the U.S. Department of Agriculture is financed largely under an AID research contract. Though Puerto Rico is a base for the research activity, related research financed from

other sources has been carried out in Colombia, and preliminary plans have been developed for on-site research in Brazil. This research is being coordinated with the tropical soils research activity of North Carolina State University under an AID research contract. Within this framework, the grant funding has served to augment the research effort. It has provided staff travel to research sites in tropical areas and minor items of supplies and services.

2. Two graduate students were on research assistantships under the grant during the past year. One is a Ph.D. candidate who is now doing his thesis research in Puerto Rico on the factors limiting plant growth on subsoils of Oxisols and Ultisols. He has a particular interest in micronutrient problems in tropical soils, and as part of his assistantship duties he has prepared an annotated bibliography of the literature on manganese and molybdenum in soils of the tropics. The other student started on a M.S. program, but because of family circumstances took a leave of absence for a year. While at Cornell, his assistantship duties involved the preparation of an annotated bibliography on "Soil Management Systems in the Tropics." Three new graduate students with a career commitment to tropical soils have been awarded assistantships for 1971-1972 under the grant.

Involvement of Other University Resources.

The grant has had a substantial impact on many of the staff in stimulating a broadened perspective in teaching and research. Five professors supported by State funds devote 10 to 20 percent of their time to tropical soils and five others contribute significantly. All the necessary facilities have

been provided to support the objectives of the grant in teaching, research and advisory and consulting services.

Personnel Involved in Tropical Soils Research and Teaching.

1. Project leader - M. Drosdoff
 2. Professorial staff - contributing
 - D. R. Bouldin - Research and teaching, soil fertility
 - D. J. Lathwell - Elementary teaching, soil fertility research
 - T. W. Scott - Elementary teaching, soil fertility research
 - M. Peech - Soil chemistry, teaching and research
 - * R. M. Weaver - Soil mineralogy, teaching and research
 - M. Alexander - Soil microbiology, research and teaching
 - R. H. Fox - Soil fertility research
 3. Graduate Students with Support from 211(d) Funds
 - D. Ritchey - Micronutrients, Professor Fox
 - G. Linvill - Cultural systems, Professor Drosdoff
 4. Graduate Students with Support from other than 211(d) Funds
 - H. Zandstra - Soil fertility, Professor Bouldin
 - G. Naderman - Cultural systems, Professor Drosdoff
 - G. Amedee - Soil chemistry and mineralogy, Professor Weaver
 - F. Ferreira - Soil fertility, Professor Scott
 - P. Santiago - Cultural systems, Professor Drosdoff
 - M. Carrasco - Soil chemistry, Professor Peech
 - B. Van Reij - Soil chemistry, Professor Peech
- * 1/2 salary from 211(d) funds.

Plan of Work, 1971-1972

The work for 1971-1972 will emphasize the following goals:

- (a) Establishing local funding for a position of Professor of Tropical Soils to insure continuation of the program beyond the end of the current 211(d) grant;
- (b) Developing research and instruction on systems of culture for crop production on tropical soils;
- (c) Developing the tropical soil component of resident instruction;
- (d) Developing collaboration and interaction with other institutions both in the United States and abroad, for mutual effectiveness in teaching, research, and consultation about tropical soils and their use.

Establishing Continuing Local Funding for a Professorial Position for Tropical Soils.

During the 1971-1972 operational year, the duties of an existing professorial position financed as a continuing line item of the departmental budget will be adjusted to include about 50 percent effort on tropical soils. Dr. M. G. Cline will serve as 211(d) project leader under this arrangement with the collaboration of Dr. M. Drosdoff. During the years that follow, the tropical soils duties of the position will be increased. The professor in that position will work intimately with the professor provided by 211(d) funding to the end of the grant. At that time, the position on 211(d) funds will terminate, but it is anticipated that a continuing position will be available to assume responsibilities

for the tropical soils program, subject to unforeseeable budgetary limitations.

Developing Instruction and Research on Systems of Culture for Crop Production on Tropical Soils.

This is the area programmed for emphasis under the 211(d) grant.

1. During 1971-1972, the initial steps will be taken to develop a formal course on cultural systems for crop production on tropical soils. Dr. J. K. Coulter, Tropical Soils Advisor, Rothamsted Agricultural Experimental Station, will be a Visiting Professor at Cornell and will develop an outline and bibliography for the course. He will work intensively with Professor Richard Fox, who is currently headquartered in Puerto Rico, for a two week period on course content and organization. It is anticipated that Professor Fox will be on the Cornell campus for one semester in 1972-1973 and in subsequent years to offer the course. Professor E. W. Russell of the University of Reading is expected to be available in 1972-1973 as a Visiting Professor for consultation with Dr. Fox.

2. The AID-sponsored research project on soil fertility in the humid tropics will continue as the nucleus of research on cultural systems for tropical soils. In addition to Professor Fox, Professors Drosdoff, Bouldin, Lathwell, Peech, Weaver, Arnold and Alexander will be actively working on this and related projects. Four graduate students supported by 211(d) funds and nine supported from other sources will be engaged in research and related instructional activities. Dr. James A. Silva, on Sabbatic leave from the University of Hawaii, will compare the response of plants to silica on Hawaiian and Puerto Rican soils.

Developing the Tropical Soil Component of Resident Instruction.

1. The literature on tropical soils available in both the departmental and the college libraries will be inventoried, and lists of available material will be prepared. A search will be made for publications on tropical soils and related subjects not available at Cornell, and important items will be purchased. Annotated bibliographies will be assembled on specific aspects of tropical soils.

2. Four visiting scientists will be brought to the campus for short periods (one week to one month) as consultants and lecturers for broadening tropical soils components of courses and graduate training. The two visiting professors, J. A. Silva and J. K. Coulter, referred to above, will serve similarly for periods of one year and six months, respectively.

3. To insure communications and interactions among the many faculty and students in varied fields of interest concerned with tropical soils, informal seminars will be held regularly for reports of individual activities, exchange of information and ideas, and discussion of relevant subjects.

4. As indicated in a previous section of this report, during 1970-1971 the two professors responsible for elementary soils teaching gained experience with tropical soils, one in a year's work in Puerto Rico and the other at the Tropical Soils Teaching Workshop in Hawaii. That experience will be applied to broaden the perspective of elementary soils teaching. Similarly, the experience of three other professors with research on tropical soils will be applied in the teaching of soil chemistry, soil fertility, and soil mineralogy. A course that requires

a ten-day study period in Puerto Rico will be continued, and the instructional staff will change to provide broader impact on resident faculty.

Developing Collaboration and Interaction with other Institutions.

1. During the 1971-1972 operational year, the first of what is intended to be continuing Tropical Soils Institutes will be offered by the Consortium. It will be an intensive four week school for professional workers in tropical soils and will carry graduate credit for successful participants. It will have inputs from all, or most, Consortium members with the objective of providing service in a cooperative program. It is planned to have the first Institute in Puerto Rico in July and August, 1972. Cornell is one of the contributing institutions.

2. During the year, each of the collaborating institutions will be visited to obtain first hand knowledge of their programs for tropical soils, to explore possibilities for exchange of staff, and to investigate potential exchange or transfer of students.

3. Each of the five visiting professors and scientists will provide a contact with a different institution overseas, and a sixth will be an additional contact with the U.S. Department of Agriculture. These contacts will be maintained as important links with institutions active in tropical soils teaching and research. Looking beyond 1971-1972, it is the intent to establish communications with these and other major institutions in the U.S. and abroad for developing an inventory at Cornell of the on-going work on tropical soils in a major segment of the world. Visits will be made to various institutions in future years for direct observation of their programs, personnel, and facilities.

Expenditures

June 30, 1970 to June 30, 1971

International travel.

F. Jurion - Belgium	\$ 401.00
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Other expenditures.

Salaries, stipends, and wages	\$ 21,235.19
Student fees	937.50
U.S. travel and subsistence	1,689.56
Supplies	555.75
Other costs	<u>411.59</u>

TOTAL	\$ 25,230.59
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Budget for Next Year

July 1, 1971 to June 30, 1972

Salaries, stipends, and wages	\$ 72,000.00
Student fees	2,500.00
International travel	4,300.00
Other travel and subsistence	6,700.00
Supplies	5,000.00
Other costs	<u>1,500.00</u>

TOTAL	\$ 92,000.00
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REPORT OF
UNIVERSITY OF HAWAII

REPORT OF THE UNIVERSITY OF HAWAII

Summary of Accomplishments and Future Plans

Major Accomplishments. The major accomplishment during the past year, involving all of the institutions in the 211(d) Consortium on Tropical Soils, was a two-week workshop on teaching basic soils and learning firsthand about tropical soils. The workshop was held during July 1971 in Hawaii. Staff from all five Institutions were involved. Travel and per diem funds came from the 211(d) Grants. The Department's basic soils course, Introduction to Tropical Soils, was restructured from a course taught by the conventional lecture-lab method to one which includes audio-visual-tutorial methods as the major teaching technique. Three new courses were added to the Department's curriculum. A series of printed "Illustrated Concepts of Tropical Agriculture" was initiated using both State and 211(d) funds.

The Department's program in soil mineralogy research which is emphasized by the 211(d) Grant has been greatly strengthened not only by the 211(d) funds but by State funds. For example, x-ray diffraction analyses has indicated that Hawaiian soils vary from principally crystalline to completely non-crystalline in form. The 211(d) Grant has provided "seed" money to augment State and Federal funds which support the remainder of our tropical soils research.

Dr. John Coulter from the Rothamsted Experiment Station and an expert on tropical soil-plant systems spent July 1 to 9, 1971 visiting the Department. The visit was made possible by the 211(d) Grant. Dr. Goro Uehara at the invitation of the Thailand AID Mission visited Thailand and Vietnam to discuss the possibility of research contracts involving the Mekong Delta.

The great interest on the part of the Consortium in the phosphorus research of Dr. Robert Fox has resulted in improved funding of this project by

College Administrators. The Administration also provided a State position for a soil mineralogist which freed 211(d) funds which were earmarked for this position. Using State and Federal funds the College purchased an x-ray fluorescence quantometer which will greatly benefit the Department's programs in soil mineralogy, soil chemistry and soil-plant relations.

Plan of Work for Next Year. If there is sufficient interest on the part of other members of the consortium, Hawaii will host a two-week workshop on teaching and research aspects of soil fertility. As a service to various AID Bureaus and Missions in Asia and the Pacific, Hawaii plans to have at least three of the soils staff travel in Asia and the Pacific. Two new graduate courses will be added, one on Directed Teaching, and another an intensive six-week summer course in Tropical Crop Production.

The x-ray fluorescence quantometer will be in operation by January 1972 at which time a Soil, Tissue, and Forage Analyses Laboratory will be established to service not only the public in Hawaii but also to some extent individuals from the Pacific Basin and East Asia. Provided sufficient funds are made available from other sources to purchase a scanning electron microscope, 211(d) funds will be used to purchase a electron micro-probe attachment for the instrument. This should greatly improve our research capabilities in soil mineralogy, and soil-plant relations at the root-soil interface.

With the combined support of 211(d) funds from Puerto Rico and Hawaii, Dr. Fred Beinroth will spend six weeks in Hawaii initiating cooperative work in geomorphology-pedogenesis, soil classification and soil characterization. Dr. Anthony Sayegh from the American University in Beirut will spend the year working on amorphous materials of Hawaiian and Lebanese soils. Dr. Sayegh is partly supported by 211(d) funds. Dr. William Sakai has joined the staff as a 211(d) Post Doctoral Fellow and will work with Dr. Jones on soil mineralogy

research. Dr. Gordon Tsuji will continue as a 211(d) Post Doctoral Fellow working on soil physics with Dr. Goro Uehara. A technician will be hired on 211(d) funds to do soil and plant analyses for the soils staff. At least two graduate research assistants will be supported by the grant.

Overseas travel will include in addition to the three proposed Asian trips, one trip to Europe to attend a Symposium on Acid Sulphate Soils and another trip (two persons) to IITA in Nigeria and other parts of Africa to consult with local soil scientists and to get a firsthand look at soil problems in Africa.

Negotiations will be initiated to develop faculty and student exchange program between Hawaii and the other four institutions.

Goals

This Grant will strengthen the existing competency of the University of Hawaii by means of a collaborative effort with Cornell University, North Carolina State University, Prairie View A&M College and the University of Puerto Rico to provide training, related research, technical assistance and consultation, and conduct related research in soil science for increasing food production in soils of the tropics. The Grant will be used to:

- (1) Further strengthen the soil mineralogy group at the University by the addition of a soil mineralogist, a technician and appropriate support and equipment.
- (2) Provide for visiting professorships to be used to bring to the University of Hawaii additional expertise and experience from either the cooperating institutions or from other services.

- (3) Provide graduate assistantships in order that students of the other four cooperating institutions may have access to the special strength of Hawaii.
- (4) Provide graduate assistantships to conduct research in tropical soils toward advanced degrees at the University of Hawaii.
- (5) Provide funds for travel by assistantships that are exchanged among the institutions, for visiting professorships and for staff to consult with other cooperating institutions.
- (6) Strengthen the existing curriculum in tropical soils so that it will be more useful to AID and other personnel involved with tropical soils, crop management and other related activities in the less developed countries.
- (7) Strengthen library and other information services with special emphasis on the preparation of manuals or other training materials on tropical soils and other related fields.

Major Accomplishments

Teaching. A major portion of the time covered by this report was devoted to preparations for a workshop which was held July 10 to 24, 1971. The workshop brought together all of the staff from the cooperating institutions who are involved in teaching basic soils in order that they could exchange ideas regarding the teaching of basic soils and to give those from the Temperate Zone an opportunity to learn more about tropical soils. The workshop involved considerable advanced preparation by the participants, particularly

Dr. Richard Green, Dr. H. Ikawa and Dr. Goro Uehara of the University of Hawaii staff. Those attending from other institutions were Dr. Thomas W. Scott and Mr. Gordon L. McCaskill from Cornell, Dr. Maurice G. Cook from North Carolina, Dr. James I. Kirkwood from Prairie View, Dr. Murray H. Milford from Texas A&M (sponsored by Prairie View), and Dr. Fred Beinroth from Puerto Rico. All of the soils staff and some graduate students from Hawaii participated in the workshop. Dr. Hank Foth, a visiting professor from Michigan State University well-known for his innovative teaching capabilities, was a very active participant. The workshop was held on three Islands, two days on Hawaii, seven days on Oahu at the Manoa Campus and six days at the Hawaii Agricultural Experiment Station's Branch Station on Kauai. Four days were devoted to field trips, one day on paddy soil training, and seven days to workshop sessions. The group was enthusiastic and the discussion lively and pertinent. It was the concensus of the group that the workshop had strengthened the teaching capabilities of the five institutions. Funds from the 211(d) Grants were used to provide travel, per diem, and for incidental expenses.

Dr. H. Ikawa, with the help of Dr. Foth, spent the summer restructuring the Department's basic soils course, Introduction to Tropical Soils, from a conventional 3-lecture, 1-laboratory course to a 2-lecture, 1-audio-visual-tutorial system with or without a laboratory section. The revamped course is being taught in the Fall of 1971. The introduction of audio-visual-tutorial techniques and the inclusion of information from the workshop has improved our ability to teach basic soils. Three new courses were offered in 1970-71, two in soils and one in crop science. An introductory course entitled "Soils and Man" was offered for non-soils majors within and outside the College of Tropical Agriculture. Soil Microbiology which has not been offered for a

number of years was given. A new course in "Plant Tissue Culture" was made available in crop science. State funds and a limited amount of 211(d) funds were used to get these courses underway.

A series of printed, single page handouts of "Illustrated Concepts in Tropical Agriculture" was initiated. Each sheet carries a single concept which should be emphasized in the teaching of tropical soils and plant nutrition. Three have been printed and are available to the members of the Consortium or to other Universities upon request. These should be particularly useful to members of the Consortium who are located in temperate climates.

Research. Soil mineralogy research has received strong support from the 211(d) Grant. Under the leadership of Dr. Rollie Jones research has indicated that Hawaiian soils analyzed by x-ray diffraction vary from systems which are principally crystalline to those which are almost completely non-crystalline in nature. Many of the soils previously analyzed by x-ray diffraction were examined by electron microscopy. An M.S. program was initiated to chemically characterize the non-crystalline properties of the soils studied. As a means of comparing techniques, x-ray diffraction analysis and electron microscopy were made of soils from Arizona, California, Montana, New Mexico, Oregon, and Wyoming. The mineralogical characterization of off-shore sediments was also initiated.

Hawaii, unlike other institutions in the consortium except Puerto Rico, does research on all phases of tropical soils. This research is supported by State and Federal funds as well as some "seed" money from the 211(d) Grant. A brief summary of research accomplished during the year follows. In the case of soil classification, emphasis was on completing the chemical and mineralogical characteristics of the soils of the 15 branch stations of

the Hawaii Agricultural Experiment Station. This was done so that the large volume of existing yield data can be correlated with these soil characteristics. If successfully correlated these data might be used on similar soils elsewhere in the tropics.

Soil fertility research emphasized the phosphate requirements of crops grown in highly weathered soils and on phosphate adsorption by these soils. This research has a strong tie to the Latin American programs of Cornell, North Carolina, and Puerto Rico. Studies were initiated on sulfate adsorption, particularly by acid subsoils where several thousand pounds of sulfur may be present but very little is available to plants. Soil amendment research dealt with the interactions among calcium silicate, lime, and phosphorus fertilizer. Nitrogen research centered around the movement of nitrogen, especially nitrate, with infiltrating water as this movement is related to the chemical and physical properties of Oxisols.

Soil physics studies involved the degradation and movement of pesticides in highly weathered soils, salinity relations and management in tropical soils (it was found that salinity had less effect on the physical properties of tropical Aridisols and Oxisols than arid soils from temperate regions) and with evapotranspiration studies to determine the consumptive use of water by sugarcane comparing sprinkler and drip irrigation. An interesting computer study compared the yields of sugarcane over a long period on alluvial soils versus Oxisols on the same plantation. In earlier years when fertility was a limiting factor, the very fertile alluvial soils outyielded the highly weathered Oxisols. With the initiation of heavy fertilization fertility has been all but eliminated as a primary limiting factor and the Oxisols have outyielded the alluvial soils in recent years. It is believed that this is because of their ability to resist compaction by heavy equipment.

Dr. John Coulter from the Rothamsted Experiment Station visited the Department from July 1 to 9. Dr. Coulter talked individually with the staff, presented a seminar on Soil-Plant Systems, and visited Branch Stations on the Islands of Kauai and Hawaii. His visit was stimulating and his written report has helped to strengthen our research program. His visit was made possible by 211(d) funds.

Dr. Goro Uehara at the invitation of the Thailand AID Mission spent two weeks in Thailand and Vietnam to discuss possible research contracts on silting and soil-water-plant research in the Mekong Delta. On his way back he visited IRRI and Central Luzon University. This also gave him the opportunity to see how former University of Hawaii graduates are doing in the Philippines and Thailand.

Involvement of Other University Resources. The 211(d) Grant has stimulated the College of Tropical Agriculture interest in overseas tropical agriculture. Although the College has been actively involved in the training of foreign students from tropical countries, its research program on the whole has been restricted to Hawaii. The implementation of comparative studies involving both Hawaii and other tropical areas should be of mutual benefit.

The great interest on the part of the Consortium in the phosphorus research of Dr. Robert Fox has resulted in a substantial increase in the financial support of this research by the Administration of the College of Tropical Agriculture. The Administration also allowed the Department to hire a soil mineralogist on State funds thus freeing the 211(d) funds earmarked for this position. This will give additional support to the mineralogical research and other soils research.

With State and Federal funds an x-ray fluorescence spectrometer has been purchased. Its ability to analyze rapidly and directly plant tissues and

soil samples should greatly accelerate the program of the Department particularly in soil mineralogy. Some attachments to this equipment were purchased with 211(d) funds.

With University and personal resources Dr. Robert Fox and Dr. James Silva attended the International Symposium on Soil Fertility in India in January-February. During this trip they traveled extensively in India, Thailand, Malaysia, Taiwan, and the Philippines. The symposium and the field trips should give both of these staff members a better appreciation of soil fertility problems in the tropics.

Resources of the University in terms of staff time were used to handle the many visitors that stop in Hawaii between Asia and mainland U.S. The number of visitors averages about one per week and time spent in the Department varies from one day to two weeks.

Personnel.

Students - Undergraduates

<u>Name</u>	<u>Major</u>	<u>B.S. Date</u>
Bouchereau, Shenal	Soils	1971
Bin Tah, Saidin	Soils	
Ching, Patrick C.	Soils	
Hoshmand, Ahmad	Agron	1971
Oya, Jean C.	Soils	
Ravenhorst, Charles	Agron	
Tengah, Abdula B. C.	Soils	
Toma, Kato	Agron	
Toshikiyo, Dennis A.	Soils	
Young, Antoine	Soils	

Graduates*			
<u>Name</u>	<u>Arrival Date</u>	<u>Advisor</u>	<u>Home Country</u>
<u>Agronomy M S</u>			
Ayers, Dennis	Fall 71	H. Y. Young	U.S.
Chaudhury, A. J. H.	Spring 70	D. Bartholomew	Pakistan
Dollah, Abdul A. B.	Spring 70	P. Rotar	Malaysia
Golingai, Sylvester	Fall 70	D. Plucknett	Malaysia
Pellek, Richard	Fall 71	Y. Tamimi	U.S.
Saito, Ronald Y.	Spring 71	D. Bartholomew	U.S.
Santo, Lance T.	Summer 71	G. Uehara	U.S.
Watanabe, Winifred	Fall 70	D. Bartholomew	U.S.
<u>Agronomy Ph D</u>			
El-Tahir, Awad	Spring 70	J. Silva	Sudan
Escalada, Rodolfo	Fall 70	D. Plucknett	Phil.
Ezumah, Humphrey	Spring 70	D. Plucknett	Nigeria
Floresca, Emmanuel	Fall 71	P. Rotar	Phil.
Guevarra, Anacleto	Fall 71	P. Rotar	Phil.
Nangju, Dimyat	Spring 70	D. Plucknett	Indonesia
Nicholls, Douglas	Fall 70	D. Plucknett	Australia
Ravoof, Abdul	Fall 69	W. Sanford	India
Seng, Tee	Spring 68	W. Sanford	Malaysia
Shin, Han Poong	Summer 70	P. Rotar	Korea
<u>Soil Science M S</u>			
Asghar, Mohammad	Fall 70	Y. Kanehiro	Pakistan
Bajar, Antonio M.	Fall 71	R. Fox	Phil.
Boonduang, Ampan	Summer 70	Y. Kanehiro	Thailand
Braide, Jonathan O.	Fall 68	G. Uehara	Nigeria
Chan, Jenn K.	Spring 70	R. Jones	Malaysia
Keng, Johnny C. W.	Summer 71	G. Uehara	Taiwan
Nishima, Melvin S.	Fall 71	P. Rotar	U.S.
Periaswamy, Sirapalli	Summer 70	H. Ikawa	India
Syed Fadzil, Syed	Spring 70	J. Silva	Malaysia
Tianco, Antonio	Fall 70	D. Bartholomew	Phil.
Uchida, Raymond S.	Fall 71	Y. Tamimi	U.S.
Wambiji, Henry	Fall 69	S. El-Swaify	Kenya

*Supported by State, East-West Center (U.S. State Department), Rockefeller and Ford Foundations, Country of Origin, FAO, etc.

Graduates (Cont.)

<u>Name</u>	<u>Arrival Date</u>	<u>Advisor</u>	<u>Home Country</u>
<u>Soil Science Ph.D.</u>			
Balasubramanian, V.	Fall 69	Y. Kanehiro	India
Dangler, Edgar	Summer 67	S. El-Swaify	U.S.
Goswami, Kishore	Fall 67	R. Green	India
Hirunburana, Niwat	Fall 69	R. Fox	Thailand
Jellinger, Alice	Spring 69	P. Ekern	U.S.
Juang, Tzo-chuan	Fall 69	G. Uehara	Taiwan
Khalid, Rashid	Summer 67	J. Silva	India
Osman, Abeld-Fatah	Summer 68	S. El-Swaify	UAR
Rao, Palakurthi	Spring 70	R. Green	India
Sinanuwong, Somsri	Fall 69	S. El-Swaify	Thailand
Syed, Muhammad M	Fall 69	S. El-Swaify	India
Watanabe, Roger	Fall 59	G. Uehara	U.S.

Supported by 211(d) Grant:
Post Doctoral Fellowship

Gordon Tsuji, Ph D. Purdue University

Speciality
Soil Physics

Supported by State Funds
Research and Teaching Staff

SoilsSpeciality

Paul C Ekern, Jr	Soil Management, Physics
Samir A El-Swaify	Soil Physics, Irrigation
Robert L Fox	Soil Fertility, Crop Management
Richard E. Green	Herbicides, Soil Physics
Haruyoshi Ikawa	Soil Mineralogy
Rollin C Jones	Soil Mineralogy Characterization
Yoshinori Kanehiro	Soil Chemistry, Fertility
Burton Koch	Soil Microbiology
Wade W. McCall**	Soil Fertility
James A. Silva	Soil Fertility, Soil Chemistry
Goro Uehara	Soil Physics, Mineralogy, Water Science
Roger T Watanabe	Soil Testing

**On sabbatical leave at University of Florida during 1970-71.

Research and Teaching Staff (Cont.)

Agronomy

Duane P. Bartholomew
 Peter P. Rotar
 Wallace G. Sanford
 Donald Plucknett
 Yusuf N. Tamim
 John R. Thompson
 Ukio Urata
 A. Sheldon Whitney***
 Hong Yip Young
 Dennis Matsuyama - Research Associate
 Ronald Yoder - Research Associate

Speciality

Crop Physiology, Plant Nutrition
 Plant Breeding, Cytogenetics
 Plant Nutrition, Physiology
 Crop Management, Weed Control
 Forest Soils, Nutrition
 Crop Production
 Plant Breeding
 Plant Nutrition, Crop Physiology
 Plant Nutrition, Chemistry

Contractual

Ramon de la Pena Root Crop Production, Crop Physiology
 Marion Mapes Tissue Culture
 Santiago Obien Weed Control
 Helen Mishima - Research Associate
 Gordon Shibao - Research Associate

***On sabbatical leave at Puerto Rico Experiment Station.

Plan of Work for 1971 - 1972

Teaching and Extension Services Because the workshop on teaching basic soils provided such a fine climate for learning (aided greatly by the facilities available, particularly the dormitory and conference facilities, on the Kauai Branch Station), depending upon demand from other members of the Consortium, Hawaii will be pleased to host another workshop in the summer of 1972. This workshop will deal with teaching and research aspects of soil fertility.

With the concurrence of other members of the Consortium, Hawaii would recommend that the people involved in each workshop should follow-up their workshops with annual meetings of shorter duration preferably in foreign tropical areas. Such meetings would serve three purposes: (1) to discuss advances in teaching and research, (2) to obtain firsthand knowledge of problems in tropical soils, and (3) to act as a service group which would be

available as consultants to AID Bureaus and Missions in the countries being visited.

Hawaii plans to budget travel funds for three overseas trips for three members of the soils staff. Where these individuals will go will depend on negotiations with the various AID Bureaus. Due to its closer proximity to the Pacific Basin and East Asia and the fact that there are large numbers of UH graduates in this area, it would seem logical for Hawaii to devote its efforts to this area of the World. The trips are budgeted accordingly.

Two new courses will be added to our curriculum. Both courses have a direct implication in the 211(d) program. One course will be a variable credit course on Directed Teaching. Hopefully such a course should better train foreign students in teaching and extension methods. The second course will be an intensive six-week course in Tropical Crop Production during the summer. It will involve tropical root and tuber crops, rice, and other grain crops, vegetables, and fruit crops. Emphasis will be placed on soil problems, physiology, and pest control. The course should be a useful service to AID and other similar agencies as well as to graduate students in this Department.

The series on "Illustrated Concepts in Tropical Agriculture" will be continued using 211(d) funds in part.

Research and Extension Services The x-ray fluorescence quantometer has been received and will be in operation by January 1972. At this time a Soil, Tissue, and Forage Analysis Laboratory will be established to serve the public and scientists within the department. It is expected that this laboratory will also be able to handle some samples from the Pacific Basin, the East Asia and from members of the Consortium. 211(d) funds will be used to hire a technician to handle the research samples and those coming in from foreign areas. State funds provide the supervisory personnel, stenographic

help, the research required to back up the recommendations given, student help, and supplies.

The purchase of the above equipment eliminated the need of updating our x-ray equipment to provide for elemental analysis which was a part of our original budget. For this reason, we will be negotiating with biological and physical science units within the University to determine if enough funds can be gathered to either purchase or lease a scanning electron microscope. If this is feasible, we will plan to use 211(d) funds to purchase an electron micro-probe attachment for the instrument. Such an instrument would be extremely useful in soil mineralogy studies and studies on mechanisms involved in the uptake of nutrients by roots and leaves.

Dr. Fred Beinroth, who is supported by 211(d) funds from Puerto Rico, will spend six weeks in Hawaii sometime in November-December period. The purpose of his trip will be to initiate a geomorphic-pedogenetic study in Hawaii, to start a cooperative project whereby soils of Hawaii and soils of Puerto Rico will be classified according to the FAO system, and to correlate the chemical and physical characteristics and behavior of soils in Puerto Rico and Hawaii which have been similarly classified under the U.S. system. He will be supported by both Puerto Rican and Hawaiian 211(d) funds.

Dr. William Sakai, a 211(d) Post Doctoral Fellow, will be helping Dr. Rollin Jones with his soil mineralogy work particularly in relation to the use of the electron microscope which is Dr. Sakai's specialty. Dr. Gordon Tsuji, another 211(d) Post Doctoral Fellow, is doing soil physics research under Dr. Goro Uehara.

Dr. Anthony Sayegh a soil scientist from the American University in Lebanon will be spending his sabbatical leave in this Department from September 1, 1971 to May 31, 1971. He will be partially supported by 211(d)

funds. He will be working on amorphous materials of Hawaii and Lebanon soils in cooperation with Dr. Rollin Jones, Dr. Samir El-Swaify, and Dr. H. Ikawa.

In addition to the soil mineralogy studies indicated, micromineralogy capabilities of tropical soils utilizing x-ray diffraction, x-ray fluorescence, scanning electron microscopy, electron probe, and transmission electron microscopy will be continued. Montmorillonites and halloysites formed under tropical conditions will be studied. An electron microscope comparison of soils from other tropical regions will be conducted with Hawaiian soils, starting first with Puerto Rican soils

In addition to the ongoing research program the following new projects are being initiated which may be of interest to other members of the 211(d) Consortium. A project will be commenced on the shallow organic soils (Tropofolists) of Hawaii to determine whether these soils should be cleared for other crops or left as forest. Another project involves a study of slow release nitrogen compounds and materials including wastes is being initiated. A third project will involve research on the physical, chemical, and biological factors which influence the uptake of nutrients by plants.

The project leader from Hawaii plans to visit the campuses of all the other cooperating Universities to determine how Hawaii might better mesh its program into those of the others and to determine the best means of implementing a program in the exchange of faculty and students. Dr. James Silva from this Department will be spending his sabbatical leave at Cornell this year. Dr. Sheldon Whitney is spending his sabbatical leave at the Puerto Rico Experiment Station working on tropical pasture management.

Foreign travel contemplated in addition to the three trips mentioned under Teaching and Extension Services will include a trip to Wageningen, Netherlands from August 15 to 20, 1972 by Dr. Robert Fox to attend a

Symposium on Acid Sulphate Soils. Dr. Fox will present a paper and will plan to make visits to Prairie View A&M and to Puerto Rico on the way to this meeting. Dr. W. G. Sanford and G. Uehara will attend the 211(d) Executive Committee which tentatively is to meet at IITA in Ibadan, Nigeria probably in March-April of 1972. They will probably visit some other African countries to consult with local soil scientists.

Personnel. In addition to the staff listed under Major Accomplishments, the following staff and students will be supported by 211(d) funds:

<u>Position</u>	<u>Name</u>	<u>Specialty</u>
Professor	Not selected	Soil Classification
Post Doctoral Fellow	Gordon Tsuji, Ph.D.	Soil Physics
Post Doctoral Fellow	William Sakai, Ph.D.	Electron Microscope
Technician	Mrs. Annie Chang, M.S.	Analytical Chemistry
Graduate Res. Asst.	Wayne Hudnall	
Graduate Res. Asst.	Mayo E. Ryder	
Graduate Res. Asst.	Raymond Uchida	

Expenditures 1970-71

Salaries and Wages	\$ 4,026
Supplies and Library Acquisitions	5,362
Equipment*	11,316
Travel	<u>3,499</u>
Total	\$24,203

*Itemized as follows

<u>Vendor</u>	<u>Description</u>	<u>Cost</u>	<u>Justification</u>
Hawaii Audio-Visual Center, Inc. Honolulu, Hawaii	Compact wide angle lantern slide projector, Buhl Model LS-1 with slide guide - 16 lbs.	\$ 273.64	Projector is required for virtually constant use in viewing electron microscope plates to determine quality, subject matter content, and planning additional work without printing plates.
Controls, Inc. Honolulu, Hawaii	103-PW Darkroom Fan, 234 cfm I.L.G. Electric Ventilating Co.	147.16	Hood fan for darkroom.
Packard Instrument Burlingame, California	Model 2111-04 Tri-Carb Automatic Liquid Scintillation Spectrometer System (line voltage and frequency: 115V 60 cycles)	5,220.00	Water relations of tropical soils, ionic equilibria in tropical soils and sulfur and phosphorus behavior in soils.

<u>Vendor</u>	<u>Description</u>	<u>Cost</u>	<u>Justification</u>
Anderson's Camera House Honolulu, Hawaii	404-820 D-6 Triple Condenser Lamp House	202.50	Darkroom equip- ment for black and white and color photo- graphy for 211(d).
Central Camera Inc. Honolulu, Hawaii	Tripod, Linhoff Nu-Line 111	135.00	same as above
Central Camera Inc. Honolulu, Hawaii	Arkay Model 150 Print Dryer	425.00	same as above
Anderson's Camera House Honolulu, Hawaii	Arkay-81-4DL Developing Tanks; Stainless Steel 2 1/2 x 10 1/2 x 9 x 13/16 with lids	142.35	same as above
Applied Research Lab. Sunland, California	Specimen Briquetting	2,350.00	Accessory equipment and supplies for the ARL 72000 Vacuum x-ray Quantometer system.
Applied Research Lab. Sunland, California	Bleuler Rotary Mill	1,500.00	same as above
	Subtotal -	\$10,395.65	
Miscellaneous (Less than \$100.00 per item)		920.35	Equipment for darkroom
	Total -	\$11,316.00	

Projected Expenditures 1971-75

	<u>71-72</u>	<u>72-73</u>	<u>73-74</u>	<u>74-75</u>
<u>Salaries and Wages</u>	\$ 83,000	\$102,448	\$ 83,973	\$ 67,520
<u>Supplies and Library Acquisitions</u>	13,600	17,600	13,600	10,600
<u>Equipment</u>				
Microprobe Attachment for scanning electron microscope ¹	26,000			
Miscellaneous	<u>3,000</u>			
Subtotal	\$ 29,000	\$ 8,100	---	---
<u>Travel</u>				
Inter-island and Out-of-State	3,000			
Overseas				
2 trips to Africa ²	4,000			
3 trips to Asia ³	<u>7,500</u>			
Subtotal	\$ 14,500	\$ 11,856	\$ 10,000	\$ 10,000
Total	\$140,100	\$140,004	\$107,573	\$ 88,120

Four Year Total	\$475,797
First Year Total	\$ 24,203
Five Year Total	\$500,000

¹Dependent on matching University funds to purchase scanning electron microscope (\$90,000).

²Two persons to attend Executive Meeting at IITA in Ibadan, Nigeria.

³Three trips for staff members to do consulting in Asia.

REPORT OF

PRAIRIE VIEW A AND M COLLEGE

SUMMARY OF CONTRIBUTIONS

Our objective is to develop and consolidate a core staff of soil scientists and students with supporting facilities to assist an international effort to increase food, fiber production in the tropics.

In working toward these goals, the following contributions have been made to the over-all university capability.

Teaching

We have prepared and submitted for approval a graduate program in tropical soils leading to a Master of Science Degree. To substantiate this program the undergraduate curricula in plant and soil science have been upgraded and revised. A Resource and Enrichment Center of Tropical Soils is being developed to supplement traditional teaching practices with audio-tutorial methods and to provide resource materials on all aspects of tropical agriculture. Presently, the audio-tutorial equipment has been installed and functioning and a substantial amount of resource material acquired.

There is a feeling of esprit-de-corps and high morale among the graduate students and staff because of their involvement in pertinent research and teaching. This attitude is becoming more evident in the undergraduates.

Research

Our research is oriented to problems bearing on savanna ecology. Two staff projects deal with pesticide retention and denradation in prairie soils, and another concerns correlation of soil pronerties

between savanna-prairie soils of diverse tropical areas.

A comprehensive project in rural development by personnel in different disciplines has been started and supported indirectly by the 211(d) grant. It concerns improving the quality of urban and rural life through intensive agriculture on small acreages near urban centers.

Other University Resources

The college has contributed space for a new soils laboratory and the Resource and Enrichment Center for tropical soils. New collections have been acquired by the library to enrich the literature in Plant and Soil Sciences. The Science Department has made available instruments which we lack to carry out analysis of plant and soil samples.

Personnel

In developing our research and teaching programs, six consultants have given seminars on subjects dealing with teaching of soils and research in tropical agriculture. Our staff attended ten conferences on diverse topics related to the objectives of 211(d).

Two senior staff were added to the soils faculty and five graduate students, three American and two Foreign, were enrolled in the Master Science program. All personnel are presently involved in soils and plant research dealing with soil mineralogy, lime and Al - P interactions, degradation and retention of pesticides, and intensive culture of truck crops on prairie soils.

GOALS

The general objective of the strengthening of the Soil Science capacity of Prairie View under the Grant will be to develop and consolidate a

core staff, supporting library, other facilities, and student support to assist in the international development program on food and fiber.

The focus of this general objective is to provide the man and brain-power required to define and help resolve soil fertility problems of tropical soil by means of research, technical assistance, and manpower training. Under the general objectives, specific objectives of the Grant Program are:

- a. To build a capacity to deal with soil fertility problems of the sub-humid tropics particularly with respect to nitrogen, phosphorus, organic matter, micro and other relevant nutrients.
- b. To develop a basic curriculum on priority soil fertility problems of sub-humid tropical soils.
- c. To recruit additional staff, and to draw upon consultant and other advisory services to structure a comprehensive research and technical assistance program relative to priority soil fertility problems in the sub-humid areas of developing nations.

The ultimate objective of this grant is to assist in the development of food and fiber production in the humid tropics. Under this program specific attention will also be given to typical and soil fertility problems under ecological conditions associated with the development of Prairie vegetation.

To this end Prairie View A&M College will collaborate with the other participating institutions for mutual sharing of competencies and resources, for strengthening weaknesses common to all, for the application of the pool of available resources to the ultimate objective.

Within the scope of the specific objective, priority emphasis will be given to increasing soil science staff and related competence and to train the manpower necessary for the ultimate purpose of the Grant.

At Prairie View this Grant will provide funds for increased competence in teaching and research on Savanna-Prairie soil fertility problems. Combined, the elements of the grant program will provide for:

1. A strong undergraduate-graduate program which will be developed in coordination with and supported by Texas A&M University. This training will include Americans for technical assistance programs and foreign nationals for service in their own countries. It will provide for formal undergraduate and graduate programs and for non-degree short courses for foreign nationals.

The plan is to work with countries and missions to select foreign students to enter the program under mission or country financing and to conduct workshops and seminars, as well as providing research training on soil fertility problems of the Savanna-Prairie region.

2. Library holdings in Soil Science and related disciplines will be increased
3. A basic soil science program and curriculum will be developed.
4. Teaching materials such as visual and audio aids will be acquired.
5. Consultants for development of the basic program and curriculum will be brought in. An urgent need exists to strongly reinforce undergraduate research and training in the area of responsibility assigned to Prairie View A&M College under the Grant.

The professional positions of project leader and visiting professor will enter the second year of the program. The first year will be devoted to program planning, consequently, staffing will consist of present staff and guest lecturers and consultants to strengthen the undergraduate and graduate programs. One of the present senior

staff or new staff will serve as Prairie View project leader on the Grant Program.

6. The Grant Program at Prairie View will be developed consistent with and in cooperation with the Grant Programs of the other participating institutions. The project leader will be responsible for working with the other institutions and incorporating the policy and program guidance of the coordinating committee into the Prairie View Grant Program.
7. Visiting professors, research associates and other talent as available will be used in the strengthening process. In the long run, Prairie View will depend upon full time staff at the professional and research associate levels.
8. The Grant will provide opportunities for graduate students to develop competencies by doing some of their work at other Grant institutions.
9. The Grant will provide an opportunity for Prairie View to identify problems in the field, to assist in institutional building, and to provide consultant assistance to AID.

PROGRAM OBJECTIVES 1970-71

To achieve the goals elucidated in the beginning of this report, our program objectives for 1970-71 under AID Grant 211(d) for Prairie View A&M College are listed below in order of highest priority:

1. The initiation and development of a graduate program in the School of Agriculture leading to a Master of Science degree in Tropical Soils.

2. The development of a Tropical Soils Resource and Enrichment Center in which both graduate and undergraduate students of Plant and Soil Science will have access to auto-tutorial equipment under the tutelage of professors trained in these methods. In the latter aspect, the equipment and personnel of the Resource Library of the College has been made available to our staff to assist us in the preparation of educational material used in auto-tutorial teaching.

MAJOR PROGRAM ACCOMPLISHMENTS

Teaching

1. The proposal for a Master of Science Degree in tropical soils was prepared and submitted to the appropriate committees for approval. Curriculum changes were made in the existing graduate program and new courses were introduced for the master of science program that emphasized tropical agriculture and soils in a world context.
2. The undergraduate curriculum in soil science has been updated to meet the educational requirements of a general agriculturist and to provide instruction prerequisite to the master of science program in tropical soils.
3. Two additional staff members were employed to teach graduate and undergraduate courses, conduct soils research and direct student research programs. One secretary was also added to the program.

Currently, five graduate students have been enrolled in the program and one undergraduate will enter next term. The graduate students have been assigned to a graduate committee and a major professor has been selected for each. They are actively engaged in their research projects. These projects were carefully designed, not only to train students in field and laboratory techniques in research, but the results are applicable to the country from which each came and to which he will return to serve.

We are particularly fortunate to have graduate students of several tropical countries, two from the Dominican Republic and one from India. We plan to conduct part of their research here and part in their own country, publishing the results jointly. This will provide a valuable link between their

country and ourselves and enhance the flow of foreign students into our program.

4. The Tropical Soils Resource and Enrichment Center has been located in a large, air conditioned, well lighted room in the Plant and Animal Industry Building. It has been partly sectioned into office spaces for four graduate students and has been equipped with calculators and typewriters for their use. Shelving for books, journals, articles, and display areas for soil monoliths (several have been completed) agricultural tools of different countries have been provided. Four auto-tutorial carrells, with auxiliary equipment have been installed. Beside the carrel equipment, available for immediate use are the following:

3 Microfiche Readers

1 Microfilm Reading Library

2 16mm Projectors

Files for microfilm, microfische, filmstrips

1 Over Projector

1 Opaque overhead projector

1 Recorder with built-in synchronizer for sound
production of slides-tape documentaries

2 Tape Recorders (Cassette)

PLANT AND SOILS COURSE OFFERINGS FOR THE PROPOSED MASTER OF SCIENCE
DEGREE IN TROPICAL SOILS

Agro. 514. Soil Microbiology (3-0) Credit 4. Soil microorganisms and their effects on soil physical and chemical characteristics, nitrogen fixation, organic matter decomposition, nitrification and denitrification.

PREREQUISITE: 9 hours of soil and 6 hours of biology or consent of instructor.
FALL 1971 - Kirkwood

Agro. 523. Plant Nutrition and Soil Fertility. A study of the most important elements for plant growth derived from the soil; their sources and availability in the soil and their functions in plant metabolism. Emphasis will be placed on nitrogen, phosphorus, potassium, calcium, sulfur, iron and magnesium, including the cause and correction of copper, aluminum, and manganese toxicity in plants.

PREREQUISITE: 9 hours of soil and 3 hours of plant physiology
FALL 1971 - Brams

Agro. 603. Soil Mineralogy in Relation to Soil Formation (3-0) Credit 3. A study of weathering processes and products in relation to pedogenic processes and soil formation, and the effect of mineralogical composition on soil properties, and on profile characteristics.

PREREQUISITE: 9 hours of soil and 3 hours of physics or consent of instructor.
SPRING 1972 - Collins

Agro. 614. Soil Physics (3-3) Credit 4. Study of the most important physical properties of soil such as; soil structure, texture, aeration, soil water and thermal relationships.

PREREQUISITE: 2 semesters of physics, 9 hours of soil or consent of instructor.
FALL 1971 - Collins

Agro. 623. Tropical Soils (3-0) Credit 3. The physical and chemical properties of tropical soil; their fertility status and effect of cultural practice on soil properties. Soil conservation and management will be considered for different soils under diverse environmental conditions and farming practices. Special consideration will be given to the yield of tropical crops and their response to cultural practices, including control of soil-borne disease, pest and weeds.

Agro. 703. Soil Fertility Problems on Savanna-Prairie Ecology (3-0) Credit 3. A consideration of management practices on Savanna-Prairie soils in relation to yield of pasture and row crops and soil properties. Particular attention will be given to the effect of lime and rotational systems on efficiency of fertilizer utilization and yield of pasture crops under varying rainfall and temperature situations.

FALL 1972 - Brams

Agro. 714. The Physical Chemistry of Soils (3-3) Credit 4. A study of the physicochemical properties of soil with particular emphasis on methods and instruments employed in characterizing clays and clay minerals, soil acidity, ionic absorption and adsorption; nutrient fixation and release and plant uptake. PREREQUISITE: 9 hours of soils 9 hours of Chemistry and 3 hours of Physics.
FALL 1971 - Mangaroo

Agro. 743. Fertilizer Technology and Usage (3-0) Credit 3. Study of problems in fertilizer manufacture, storage, use and application. Chemical reactions of fertilizer when applied to soil. Fertilizer recommendation according to soil type.
SUMMER 1972 - Mangaroo

Agro. 802 Special Problems: (3-0) Credit 3 Staff

- a. Soil Plant Relation
- b. Clay mineralogy
- c. Micro pedology
- d. Chemistry of soil organic matter
- e. Thesis
- f. Environmental quality
- g. Soil Survey and Photographic interpretation

Agro. 800 Research Credit (1-6) Staff

Agro. 801 Seminar Credit (1) Staff

COURSES IN RELATED AREAS

Plant Science 543. Advanced Pasture and Range Management. (3-0) Credit 3. Types of pasture and range vegetation, methods of establishment and improvement. At least 3 field trips to pasture and range areas will be required.
1st SUMMER TERM - Staff

Plant Science 733. Grain and Fiber Crop Production (3-0) Credit 3. Study of grain and fiber ecology, utilization, physiology and morphology, cultural practices.
2nd SUMMER TERM - Smith

Plant Science 563. Disease of Field Crops. (2-2) Credit 3. Common diseases found in field crops and the best methods of control.

Biology 613. Advanced Plant Physiology. (3-0) Credit 3. Study of chemical composition of plants and processes involved in plant nutrition; photosynthesis, respiration, transpiration, solute and nutrient absorption, etc.

UPDATED UNDERGRADUATE CURRICULA IN PLANT AND SOIL SCIENCE

The curricula in Plant and Soil Science are designed to be flexible enough to meet the needs and interests of the students. They allow students to prepare for either direct entry into industry or international agriculture, and agricultural education at the Bachelor of Science level or proceed into graduate training.

A student's program may be adapted so that he may put major emphasis in Agronomy, Horticulture or Soil Science. Electives are chosen from a list approved by the Plant and Soil Science Faculty Committee. To qualify as a Soil Scientist under Civil Service requirements, 15 credit hours of technical soils are required.

AREA OF PLANT AND SOIL SCIENCE
(Soil Science Emphasis)

Freshman Year

First Semester

English 113
Mathematics 113, 115 or 173
Nursing 111
Biology 134
Animal Science 113
Physical Education 111
Military Science 112

17 hours

Second Semester

English 123
Mathematics 123, 125 or 183
Nursing 121
Biology 114 or 115
Plant Science 103
Physical Education 121
Military Science 122

17 hours

Sophomore YearFirst Semester

English 213
 History 173
 Political Science 113
 Chemistry 114 or 115
 Agronomy 323
 Physical Education 211
 Military Science 212

 19 hours
Second Semester

English 223
 History 183
 Political Science 123
 Chemistry 124 or 125
 Agronomy 443
 Physical Education 221
 Military Science 222

 19 hours
Junior YearFirst Semester

Chemistry 314
 Mathematics 433
 Agri. Economics 223
 Civil Engineering 353
 Electives (4)

 17 hours
Second Semester

Chemistry 214 or 434
 Agronomy 423
 Biology 334
 Agri. Engineering 123
 Electives (4)

 18 hours
Senior YearFirst Semester

Agronomy 403
 Sociology 263 or 273
 Agronomy 433
 Electives (7)

 16 hours
Second Semester

Agronomy 454
 Civil Engineering 323
 Plant Science 401
 Electives (5 - 8)

 17 hours

1. Electives will be chosen from a list approved by Plant and Soil Science Faculty Committee.
2. To qualify as a Soil Scientist under Civil Service requirements, 15 credit hours of technical soils are required.

AREA OF PLANT AND SOIL SCIENCE
(Agronomy or Horticulture Emphasis)

Freshman Year

First Semester

English 113
Mathematics 113, 115 or 173
Nursing 111
Biology 134
Animal Science 113
Physical Education 111
Military Science 112

17 hours

Second Semester

English 123
Mathematics 123, 125 or 183
Nursing 121
Biology 114 or 115
Plant Science 103
Physical Education 121
Military Science 122

17 hours

Sophomore Year

First Semester

English 213
History 173
Political Science 113
Chemistry 114 or 115
Agronomy 323
Physical Education 211
Military Science 212

19 hours

Second Semester

English 223
History 183
Political Science 123
Chemistry 124 or 125
Agronomy 443
Physical Education 221
Military Science 222

19 hours

Junior Year

First Semester

Chemistry 314
Biology 254
Agricultural Econ. 223
Electives (7)

18 hours

Second Semester

Chemistry 324 or 434
Biology 464
Agri. Engineering 123
Electives (3)

17 hours

Senior YearFirst Semester

Entomology 323
 Biology 334
 Mathematics 433
 Agronomy 400
 Electives (3 - 6)

 17 hours
Second Semester

Agri. Economics 423
 Sociology 263 or 273
 Plant Science 401
 Electives (9)

 17 hours

1. Electives will be chosen from a list approved by Plant and Soil Science Faculty Committee.

COURSE DESCRIPTIONS FOR UNDERGRADUATE CURRICULA
 IN PLANT AND SOIL SCIENCE

(Including new courses)

1. Agronomy 303 --- Grain and Fiber Crops

Study of geographical distribution and economic importance; classification and physiology; and principles of production of grain and fiber crops. (First semester, alternate years beginning 1971).

2. Agronomy 323 --- Soils

Nature and properties of soils including origin, formation and biological, chemical and physical aspects. (First semester every year.)

3. Agronomy 400 --- Special Problems in Soil-Plant Relationships

For individual research by advanced undergraduates on topics not included in established courses but chosen so as to demonstrate the use of the scientific approach in problem solving. (First and second semesters every year beginning 1971.)

4. Agronomy 403 --- Soil Management

The profitable management of soil with respect to the use of drainage and irrigation, organic matter content, tillage and conservation practices, cropping sequences, soil reaction and liming, fertilizer and micro-nutrients, and geographical distribution. (First semester, alternate years beginning 1971.)

5. Agronomy 413 --- Forage Crops

Production, utilization, adaptation and identification of major forage plants in grassland regions. (First semester alternate years beginning 1972.)

6. Agronomy 423 --- Soil Conservation and Land Use

Soil resources of the United States and methods and plans for soil conservation including control of erosion, interpretation of soil survey maps and land evaluation for farm crops, fruits, forestry engineering and wildlife. Soil judging. (Second semester every year beginning 1971.)

7. Agronomy 433 --- Soil Classification and Morphology

Field study of morphological features of soil profiles and the morphological characterizations of soils. Interpretation of profiles in relation to land utilization. Preparation of land use reports based upon soil maps. (First semester, alternate years beginning 1972.)

8. Agronomy 443 --- Soil Fertility and Fertilizers

Influence of soil chemical, physical and microbiological properties on crop production. Fertilizer preparation and usage. Assessment of the fertility of soils and the alteration of fertility by the use of fertilizers lime, manure and cropping systems. (Second semester, every year, beginning 1971.)

9. Agronomy 454 --- Soil Chemistry

Chemistry of mineral weathering and soil formation, ion activities, ionic exchange equilibrium relations, soil pH, specific elements and their chemical analysis and availability of nutrients to plants. (Second semester, alternate years beginning 1972.)

10. Agronomy 473 --- Agricultural Chemicals

Study of the fundamentals underlying the economical use of fertilizers, herbicides and other agricultural chemicals. Emphasis will be given to relationships with soils properties and plant growth with respect to their selectivity and fate. (First semester, alternate years beginning 1972.)

11. Agronomy 483 --- Range and Pasture Management
Adaptation and management of pasture plants in permanent and temporary pastures. Ecology and management of grass and range lands. (Second semester, alternate years, beginning 1972.)
12. Agronomy 496 --- Principles of Field Crops
Distribution, morphology, identification, physiology, management and utilization of field crops for food and fiber, for hay silage, and pasture, for livestock and for soil improvement and conservation. (First semester, alternate years beginning 1971.)
13. Plant Science 103 --- Introductory Plant Science
Science of crop and horticultural plant production; relation of environment to plant physiology; botany of crop and horticultural plants; plant structure in relation to cultural practices. (First and second semesters every year, beginning 1971.)
14. Plant Science 313 --- Landscape Design
Appreciation and use of ornamental plant materials. Fundamental principles underlying the use of these materials in urban, suburban and rural planning. (First semester, alternate years beginning 1971.)
15. Plant Science 323 --- Vegetable Production
An introduction to the growth habits, soil and climatic requirements, storage, varietal characteristics and pest control of vegetable crops. (Second semester, alternate years beginning 1972.)
16. Plant Science 343 --- Floricultural Crop Production
Scientific principles and practices involved in production, distribution, marketing and use of flowers. (Second semester, alternate years beginning 1972.)
17. Plant Science 403 --- Plant Breeding and Improvement
Genetic and cytological variations in crop plants, the production and control of such variations in developing varieties and hybrids, and the maintenance of high quality seed stocks. (First semester, alternate years beginning 1971.)
18. Plant Science 423 --- Plant Pathology
Introduction to fundamental principles of plant pathology including isolation, diagnosis of the cause, and control of plant diseases. (Second semester, alternate years beginning, 1972.)

19. Plant Science 443 --- Orchard Management
Planting, maintenance and management of orchards (Second semester, alternate years beginning 1971.)
20. Plant Science 453 --- Plant Propagation
Propagation of plants, nursery development. (First semester, alternate years beginning 1971.)
21. Plant Science 463 --- Ornamental Plant Management
Planting maintenance and management of ornamentals. (Second semester, alternate years beginning 1971.)
22. Plant Science 473 --- Nursery and Greenhouse Crops
Production, harvesting, grading and distribution of plants grown in nurseries and green houses. (First semester every year, beginning 1971.)
23. Plant and Soil Science 401 --- Seminar
Presentation and discussions led by senior graduate students and staff on topics of individual research. (Second semester every year beginning 1971.)

CLIMATE OF LEARNING

There is a definite feeling of enthusiasm by all personnel about the new programs in Plant and Soil Science. This is particularly evident in the graduate students who are now participating in pertinent research projects and classroom discussion. This attitude is always conducive for better learning. The prospects for better positions in all phases of agriculture as indicated by visiting lecturers in agriculture industry and U.S. governmental agencies have intensified the motivation for better training. This attitude is filtering to the undergraduate students as evident by an increase in inquiries concerning careers in agri-business particularly in soil and plant sciences.

Research

Staff research projects approved by Texas Agricultural Experiment Station (TAES Cooperative State Research Service (CSRS) and Agricultural Research Service (ARS) and initiated during 1970-71 in Plant and Soil Sciences are listed:

- A. Interaction of Pesticides with Soil Microorganisms and Subsequent Effects in The Ecosystem.
- B. Mineral Nutrition of Soybeans in Relation to Fertilization and Plant Growth Regulation
- C. Movement of Pesticides in Soil and Water as Related to Rainfall Runoff and Infiltration
- D. The Adsorption and Strength of Bonding Zinc in Texas Soils.

In addition to the above research projects a documentary entitled, "The Culture of Sierra Leone, West Africa" was prepared with the cooperation of Dr. Mercedes Sandoval, Anthropologist, Miami-Dade-Junior College from materials (slides, music, conversation) obtained in that country during the past three years.

Graduate research projects that have been initiated this year are listed as:

1. Responses of Different Grass Species to Diverse Levels of Fertilization on Fine Sandy Soils of Texas Coastal Prairie.
2. Influence of Lime on Aluminum saturation and phosphorus Availability of Fine Sandy Soils of The Texas Coastal Prairie.
3. Microbial Degradation of Certain Herbicides in Sandy Soils.
4. Protein Level of Soybean as a Function of Age and Soil Fertility.

Involvement of University Resources

The library of Prairie View A&M has ordered the publications* at our request in order to support research and development activities in soils.

The library facilities of Texas A&M were made available to us for duplicating journal articles and microfilms of texts and dissertations.

- *Acta Botanica Neerlandica
- *Advances in Agronomy
- Agronomy Journal
- American Journal of Botany
- *Annual of Botany
- *Annual Review of Plant Physiology
- Archives Biochemistry and Biophysics
- *Australian Journal of Agricultural Research
- *Australian Journal of Biological Science
- *Australian Journal of Botany
- *Beiträge zur Mineralogic and Petrographie
- Biochemical Journal
- *Biochem. Biophys. Acta
- *Biometrics
- *Botanical Gazette
- Botanical Review
- *Canadian Journal of Agricultural Science
- *Canadian Journal of Botany
- Canadian Journal of Plant Science
- Canadian Journal of Soil Science
- Crop Science
- International Congress of Soil Science
- *Journal of Agricultural Research

- *Plant and Soil
- *Tropical Soils
- *Tropical Grassland Farming
- *Journal of Agricultural Science (London)
- Journal of Bacteriology
- *Journal of Botany
- Journal of Biol. Chem.
- *Journal of Cell Biol.
- *Journal of Experimental Biology
- *Journal of General Microbiology
- *Journal of General Physiology
- *Journal of Soil Science
- *Netherlands Journal of Agricultural Science
- *New Zealand Journal of Agriculture
- *Physiologia Plantarum
- Phytopathology
- *Plant and Cell Physiology
- Plant Physiology
- Science
- Soil Science
- *Soil Fertilizers
- *Soviet Soil Science
- * The American Mineralogist
- * Zeitschrift Fur Kristallographie
- *Zeitschrift Fur Pflanzem., Dunq., Bodenkunde
- Journal of Food and Agricultural Chemistry
- *Proceeding of Soil Science Society of America

The college has released space and is now constructing a second soils laboratory for teaching and research of soils from different tropical areas of the world.

The Science Department has made equipment available to us for use in the dialysis of soil tissue. This equipment is used for student training in soil and plant research.

Personnel

Senior faculty added to present Soil Science staff at Prairie View A&M College.

Dr. Johnnie B. Collins, Ph.D. Assistant Professor of Plant and Soil Sciences; Soil Genesis, morphology, classification, and soil mineralogy. In addition, he has had considerable experience in soil survey and interpretation and participated in a tropical soil workshop in Puerto Rico and the Virgin Islands.

Dr. Eugene Brams, Ph.D. Assistant Professor of Plant and Soil Science, Plant Nutrition and Soil Fertility. Dr. Brams served as Soil Specialist and Research Coordinator for Njala University College in Sierra Leone, West Africa, under University of Illinois/AID Contract.

Supporting Staff: Secretary, Miss Dorothy M. Davis. Bachelor of Science degree in Business Education; a graduate of Prairie View A&M College. Her job experiences include: working as a Tutor-Counselor for the Upward Bound Project 1967; Junior Manager of the Women Resident Hall, 1966-69. She is a member of the Texas State Teacher's Association.

During the past year, staff members of Soil and Plant Science attended workshops and seminars. The following is a list of the participants and the conferences they attended:

Oliver E. Smith	Use of Computers in Biological Science Texas A&M University, College Station Texas
Oliver E. Smith	Plant Roots and Their Environment, Virginia Polytechnic Inst Blacksburg, Virginia
Arthur S. Mangaroo	Conference for AID sponsored research on Soils and Fertilizer in Latin America. North Carolina State, Raleigh, North Carolina
Arthur S. Mangaroo	Modern Fertilizer Technology, T.V.A. Muscle Shoals, Alabama
James I. Kirkwood	Role of Soil Science in Improving Tropical Agricultural Systems, Texas A&M University College Station, Texas
James I. Kirkwood	Courses in Tropical Soils and Inter-University Research and Training in Tropical Soils - Puerto Rico
James I. Kirkwood	Tropical Soils Teaching Workshop by 211(d) University of Hawaii, Honolulu
Eugene Brams	American Society Agronomy Convention, New York. Paper: "Yields in Response of Residual Phosphorus in Tropical Alluvial Soils under Sustained Cultivation."
Eugene Brams	Conference on Auto-tutorial Techniques - Kodak Company, Houston, Texas

Prairie View A&M College invited several consultants to discuss special problems in agriculture with our staff and graduate students. The following is a list of consultants who visited the campus last year:

Area of Interest

Dr. A. Burger, University of Illinois	Auto-tutorial Methods in Agronomy
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Dr. J. Collins, Michigan State University	Soil Classification in the Tropics
Dr. Murray Milford, Texas A&M University	Development of Soil Resource Center
Dr. Hollis Bowen, Texas A&M University	Cultivation of Orchard Crops in Sub-tropical Environments
Dr. Eugene Brams, University of Illinois	Soil Problems in Agricultural Development of the Humid Tropics of Africa
Dr. Gordon McKee, United States Department of Agriculture	Problems of Soil Conservation of Prairie Lands

PLAN OF WORK FOR NEXT YEAR

Teaching

1. Formal approval of the graduate program for a Master Degree in Tropical Soils.
2. Inclusion of five more graduate students, preferably foreign nationals from tropical areas, into our program under the student assistantships provided for in 211(d) for ten students in tropical soils.
3. Interchange of staff personnel between the universities of the consortium in workshops and seminars of tropical soils. We plan to involve one or two staff members as contributors in the Institute for Soil Scientists scheduled for August 1972 in Puerto Rico.
4. Exchange of graduate students between member institutions of the consortium for study periods of at least one semester or longer, if possible.
5. Continual expansion of the Tropical Soil Resource and Enrichment Center particularly, the production of documentaries of soils in agriculture and films of techniques in the research and study of soil science.
6. An increase in the collection of agricultural publications in the college library.

Research

A comprehensive, integrated, and vital soils research program in savanna-prairie ecology involving the following areas of investigation has been instigated:

- A. The mineralogy of the clay colloids of savanna-prairie soils. A correlation of the mineralogical properties of savanna-prairie soils of diverse tropical areas.
- B. Management of soil fertility under grassland farming as it affects soil properties, forage yields and quality.
- C. Residual effects of herbicides and insecticides on forage yields, and production of organic matter and microbial populations in surface soils.
- D. The influence of soil treatments such as, herbicides, clay amendments, lime, fertilizer, and manure on availability of soil Al, Fe, P, and micro-nutrients as they affect nutrient uptake, plant yield and quality.
- E. Evaluation of tropical legumes under savanna ecology.
- F. Development of cropping systems for prairie-savanna soils and their effects on crop yields, soil properties, fauna and flora of the ecosystem, and finally the economics or influence on human resources.

To enrich these projects, we plan to rotate staff for short-term overseas assignments with research institutions or universities in tropical countries, particularly Africa.

Supporting research to Grant 211(d) (see above) will come under an encompassing project funded by a Special Grant of 1890 Colleges, entitled: "The Economic Potential of Intensive Farming On Small Acreage Near Large Urban Centers: An Incentive for Rural Stabilization and Immigration."

Three lines of investigation will be pursued under this project:

1. Evaluation of Peach Culture
2. Evaluation of Blueberry Culture
3. Evaluation of Vegetable Culture in the field with emphasis on sweet corn and tomatoes.

It is hoped this work will yield information which will enable some people now living under depressed economic conditions in urban centers to achieve better living conditions and earn higher incomes from intensive farming of 5-10 acres on the periphery of the large urban market. Of importance is the productivity of the Gulf Coastal Prairie soils under such an intensive agricultural system.

Staff and equipment committed to the 211(d) project will be used to implement the above project of rural development. It is through the input of the 211(d) Grant staff that made it possible to go ahead on this project. The results obtained here can feed-back to the 211(d) mission and significantly contribute to our understanding and use of savanna-prairie soils

Involvement with University Resources

To strengthen our research capabilities in Plant and Soil Science, the college has arranged for the acquisition of 3 green houses to conduct our studies in plant physiology. The description of the installation, which is an institutional input to 211(d) follows. The cost approaches \$120,000

The basic concept of the complete design is to provide three separate greenhouses, one for Faculty-Research Activities, one for tropical propagation and display, and one for student practice and teaching activities. Student activities are planned in the Greenhouse nearest the campus with the Faculty-Research Greenhouse located on the opposite end for maximum separation of the two functions, and the tropical propagation and display Greenhouse between these for accessibility by both groups. Exterior walks are provided interconnecting all green houses at both ends. This arrangement separates the three functions of the facility, while allowing

the necessary traffic flow between the areas without interruption or interference.

The Greenhouse facilities are furnished complete with a separate step control system for each greenhouse, complete with humidity control for automatic control of heating, cooling, and humidity of each greenhouse. A future central fertilizer injected automatic watering system was considered in the design, and capped stub-ups located at each bench but the system is not included at this time. Redwood and wire potting benches are included in the greenhouses base bid.

The headhouse facilities are planned to be constructed in the future because of the directed budget limitations and the lack of sanitary facilities in the vicinity of the site at present, and are not included in this presentation or estimates of costs.

We propose to become involved in the education and training of Peace Corps volunteers in the principles of soil science as they relate to the utilization of tropical soils. Although this program is under the auspices of Agricultural Education, the staff under 211(d), with the resources available, will contribute to this training program.

A liaison has been established with the Soil Conservation Service and this organization is cooperating with us in the location of typical pedons of several soil series that have been selected for study. The results of this study will be extended to other subtropical and tropical countries of the world.

In addition to the library acquisitions of texts and journals, the college office of publication is assisting us in developing a depository of

printed materials of work done of the staff under 211(d) which shall be available for distribution to members of the Consortium as well as outside institutions. Presently, three papers are in preparation, one, the characteristics of the prairie soils at Prairie View A&M, Texas Agricultural Experiment Station and, two, the correlation of properties of savanna soils from different tropical locals and three, the feasibility of maize as a second crop for the upland soils of Sierra Leone, West Africa.

International Travel

We plan to visit the International Institute of Tropical Agriculture group in Nigeria next year for the purpose of discussion and direction planning for the study cropping systems in the tropics. Dr. James Kirkwood and Eugene Brams plus a graduate assistant have tentatively been selected.

This will enable our research program to fit into the overall plan for tropical cropping systems.

The itinerary planned will permit visits to several West African countries where consultation with ministries of agriculture, treks into the interior, examination of research facilities will greatly enhance our understanding of the plant-soil problem in agriculture of the tropics.

SUMMARIZED FISCAL REPORT
June 30, 1970 - August 31, 1971

DESCRIPTION	BUDGETED AMOUNT	TOTAL EXPENDITURES	BALANCE
Personnel Services	\$ 51,438.00	\$ 25,352.77	\$ 26,085.23
Travel	9,332.00	3,404.00	5,928.00
Communications	1,650.00	195.10	1,454.90
General Supplies	3,803.00	2,066.04	1,736.96
Computer Time	2,025.00		2,025.00
Library Acquisitions	7,000.00	6,244.68	755.32
	<u>\$ 75,248.00</u>	<u>\$ 37,262.59</u>	<u>\$ 37,985.41</u>

ITEMIZED FISCAL REPORT

June 30, 1970 - August 31, 1971

1.	Assoc. Prof. Soil Sci.	100%	\$ 2268.00
2.	Assoc. Prof. Soil Sci.	100%	2268.00
3.	Res. Assoc. Soil Sci	100%	6945.66
4.	Secretary	100%	918.40
5.	Consultants Short term		928.00
6.	Graduate Fellowships \$300/mo./ea.		1900.00
7.	Undergrad. Asst. 15/hr/wk/\$1.60/hr		2512.00
8.	Irregular Labor		4356.41
9.	Personnel Benefits		1483.49
10.	Travel (Domestic)		3559.70
11.	Communications		1655.91
12.	General Supplies a) Teaching, Demonstration b) Lab and Greenhouse		1943.21
13.	Library Acquisitions 1. Microfiche Reader 2. Microfilm Reader 3. Movie Projector 16mm 4. Ultrafische Reader 5. Books, Journals, Microfilm Tapes, transparencies		6523.81
	GRAND TOTAL		\$ 37,262.59

PROJECTED ITEMIZED BUDGET
FISCAL YEAR September 1, 1971 - August 31, 1972

PERSONNEL SERVICES:

1. Assoc. Prof. Soil Sci., Dr. Johnny B. Collins	100%	\$ 16,008/12
2. Professor, Soil Sci., Dr. James I. Kirkwood	50%	10,056/12
3. Assoc. Prof. Soil Sci., Dr. Eugene Brams	100%	16,008/12
4. Research Assoc., Mr. Y. P. Chang	100%	8,100/12
5. Secretary	100%	4,476/12
6. Consultants (short term) 8 U.S., ave. 3 days @ \$100/da		2,400
2 Int. ave 3 days @ \$100/da		600
7. Grad. Fellowships, 7 @ \$300/mo/ea	25%	25,200/12
8. Undergrad. Assts. (10) 15 hr/wk/for 52/wks @ \$1.60/hr		12,480
9. Wages, for irregular laborers		3,582
10. TOTAL SALARIES		\$ 98,910
11. Personnel		7,790
TOTAL PERSONNEL SERVICES		\$ 101,700
12. Travel		
A. 8 U.S. @ \$250/ea		2,000
2 Int., @ \$600/ea		1,200
Per diem 30 da @ \$17/da		510

B. Program Representative	
2 trips via air @ \$250/ea to go to other Grant Institutions + per diem, 3 da/trip @ \$17/da.	702
C. Project Director	
I. 2 trips via air @ \$250 ea + per diem, 3 da/trip @ \$17/da to go to other Grant Institutions	702
II. 4 Int. trips via air @ \$600/trip + per diem, \$17/da to Carribean, S. Amer., Africa, for min. of 5 days	2,740
III. 6 trips via auto @ 100 miles + per diem, \$14/da., to Texas A&M Univ.	138
D. Soils Staff	
4 Int trips via air @ \$600/trip + per diem, \$17/da to Carribean, S. Amer., Africa, for min. of 5 days	2,740
E. Texas A&M Consultants	
6 trips via auto, 100 mi. + per diem of \$14/da., to Prairie View	138
F. Student Assistants	
I. 2 trips via air @ \$250/ea + per diem, 3 da/trip @ \$17/da to other Grant Institutions	702
II. 4 trips via air @ \$600/trip + per diem \$17/da to Carribean, S. Amer. Afr for min. of 5 days	2,740
G. In-state Auto travel + per diem by personnel to laboratory supply houses, experiment stations, field trips	500
TOTAL	14 712

13. Communications	1,650
Expendable office supplies postage, telephone, printing	
14. General supplies	3,000
Teaching supplies and laboratory	
15. Computer time	2,025
16. Library Acquisitions	7,000
8 Carrells, Auto-tutorial	
GRAND TOTAL	\$ 130,187

REPORT OF
NORTH CAROLINA STATE UNIVERSITY

REPORT OF NORTH CAROLINA STATE UNIVERSITY

Summary of Contributions

The competency of North Carolina State University as a center of expertise on soil fertility-plant nutrient relationships in soils of the tropics is being significantly and measurably strengthened through the financial support provided by a grant under the 211(d) program. Some specific manifestations of these improvements are: (1) addition of a professor of tropical soils to the faculty, (2) on-site studies of soil properties in tropical zones by six Soil Science Department senior faculty, (3) modification in the content of four courses in soil science to add additional emphasis to the characteristics of soils of the tropics, (4) initiation of two research projects to acquire additional information on comparative genesis and fertility-related characteristics on soils of tropical and temperate regions, and (5) consultation with soil scientists and other agricultural leaders in governmental and foundation organizations serving in the tropical regions.

Extensive and detailed plans are being developed to strengthen further this competency by increasing the exposure of the faculty to situations existing in tropical regions and concepts related to soils of these regions. This effect will be accomplished through a departmental tropical soils research program in three major ecological regions of tropical Latin America, visiting lecturers, and active involvement in teaching programs.

Goals

The grant awarded to North Carolina State University under section 211(d) of the Foreign Assistance Act of 1966 is entitled: "A Grant to

Strengthen the Capabilities of North Carolina State University in Special Problems of Tropical Soils." The field of concentration is soil fertility relating plant nutrition to the physical and chemical properties of humid tropical soils. The grant is for a five-year period; the initiation date was November 2, 1970. It is administered through the Soil Science Department and will be used to:

(1) Establish a senior faculty professorial position in tropical soils, who will serve as the project leader and will coordinate efforts with those of the other four cooperating universities and other departmental research activities in the tropical regions.

(2) Provide visiting professorships through which North Carolina State University will bring additional expertise and experience from the other cooperating institutions and from other sources.

(3) Provide exchange graduate assistantships so that students of the four cooperating institutions may have access to special strengths of North Carolina State, for example, courses, consultation or use of research facilities, not available at the institutions in which they are enrolled.

(4) Provide graduate research assistantships for students in tropical soils in North Carolina State degree programs.

(5) Provide (a) for travel of graduate students to tropical areas for training, (b) for support of such students while overseas, and (c) for travel and support of faculty to supervise them and to consult with cooperating institutions and agencies.

(6) Modify existing soil courses and develop new courses in tropical soils for use by AID and other personnel involved in tropical soil and crop management and related activities in the less developed countries.

(7) Strengthen library and other informational services and provide support for the preparation of training materials on soil and crop management in the tropics.

Major Accomplishments

Teaching: Dr. M. G. Cook participated in a workshop in the summer, 1971, on course content and teaching concepts on temperate and tropical soils with emphasis on the latter. The workshop was sponsored by the Consortium and hosted by the University of Hawaii. Dr. Cook is in-charge of undergraduate programs in Soil Science at North Carolina State University and is coordinator of graduate course offerings.

Three members of the faculty who are engaged in teaching undergraduate and graduate level courses have made on-site visits to tropical regions under sponsorship of the grant. The information obtained from study and observations of local conditions and consultation and discussions with local soil scientists on the unique properties and management of soils in the tropical regions has been used in modification of courses which they teach. The courses involved, the instructors and the nature of the modification follows:

1. Introductory Soils, SSC 200, Dr. M. G. Cook.

The interaction of soil forming factors, especially time, is discussed with a different emphasis as a result of observing soils whose genetic variables are different from those in the continental United States. More attention will be given to the hydrous oxide clays, their physical and chemical behavior and implications in soil usage.

2. Soil Classification, SSC 452, Dr. M. G. Cook.

More attention is given to the characteristics and classification

of the Oxisols. Important suborders, for example, Andepts, have been added to those discussed previously. Criteria for soil classification is discussed more fully with the additional knowledge of soil properties in tropical and subtropical regions.

2. Soil Mineralogy, SSC 553, Dr. M. G. Cook.

Considerably more time is being allocated to the structure, composition, behavior and practical implications of hydrous oxide clays. Methods for mineralogical analysis of soils high in hydrous oxides and amorphous materials are receiving more attention since such analyses may be conducted and interpreted somewhat differently than those for soils containing primarily silicate clays.

3. Soil Fertility, SSC 541, Dr. E. J. Kamprath.

In the discussion of soil acidity and liming, similarity in the cation saturation of the highly weathered acid soils of the tropics and the acid soils of the southeastern United States is discussed. The response to liming of tropical soils is related to neutralization of exchangeable aluminum which is obtained at relatively low rates, 1 to 2 tons/ha. The similarity of the reactions of fertilizer phosphorus in the soils of tropical regions to those in the southeastern United States is discussed. The extremely high phosphorus fixation of volcanic ash soils containing allophane and its implication in applying fertilizer phosphorus is discussed. Examples from tropical regions will be included in the discussion on the various topics covered in the course.

4. Soil Genesis and Classification, SSC 551, Dr. S. W. Buol.

Photographs were taken of soil profiles and their geomorphic position on the landscape and they will be used to document and serve as reference for

discussions on the genesis and classification of soils of the region. They include Tropudalfs, Tropaqualfs, Tropudults, Tropofluevents, Tropaquepts and Paleudults from the Amazon Basin in Peru and Tropaquepts, Quartipsamments and Tropudults from the coastal plain, deep-sand areas and inland savanna of Guyana. Also, micromonoliths were prepared from these soils for use in displays and study in our tropical soils work. The trips have provided valuable experience, which greatly increase the fluency and confidence of the professor in speaking, culture, and management practices in tropical areas.

Research: There currently are two students on doctoral degree programs funded under the 211(d) grant. Their research programs are making direct contributions to the department's knowledge and expertise on tropical soils.

1. Mr. Michael A. Granger is a native of Guyana. The objective of his research is to compare the potassium release characteristic of certain soils from eastern North Carolina with those of related soils in Guyana. The information obtained from this study will be useful in evaluating the extent to which data on certain fundamental properties of soils from temperate regions can be extrapolated, for practical application, to the management of soils in tropical regions. This research is under the direction of Dr. S. W. Buol.

2. Mr. Fred T. Turner was formerly a research fellow with the Ford Foundation and located in India. The objective of his research is to study the phosphorus availability characteristics of soils used for paddy rice production in tropical regions. The information acquired will be useful in considerations on the use of soil testing as a guide in phosphorus fertilization of paddy rice. This research is under the direction of Dr. J. W. Gilliam.

The department is engaged in several research programs under a Tropical Soils Research Project funded by AID, (Contract AID/csd 2806). This work is highly complementary to the objectives of the 211(d) grant. Information obtained from investigations on soil test-fertilizer response correlations and on methods of analyses conducted by personnel working jointly on the 211(d) program and the International Soil Fertility Evaluation and Improvement project (AID/1a 646) are making valuable contributions to the overall understanding of tropical soils by the entire faculty.

Services and Consultation: Drs. W. V. Bartholomew, R. B. Cate, Jr., J. W. Fitts, P. A. Sanchez and D. L. Waugh were invited by USAID/India to participate in the presentations and discussions at the International Symposium on Soil Fertility Evaluation in New Delhi in February, 1971. Dr. J. W. Fitts provided consultation on the use of soil testing as a guide to fertilizer use at the Southeast Asia Soils Research Institute in Kyoto, Japan. Dr. W. V. Bartholomew discussed nitrogen fertilization at various institutes in Thailand and the Phillipines. Dr. P. A. Sanchez serves on the advisory committee on rice fertilization to the Tennessee Valley Authority and is involved in testing slow release nitrogen fertilizers in Peru. Drs. S. W. Buol and P. A. Sanchez consulted with the Peruvian Ministry of Agriculture on matters pertaining to the establishment of a research center in the Selva region to study soil management under shifting cultivation, including a soil characterization study of the proposed property. Drs. P. A. Sanchez and C. B. McCants presented papers at a symposium on nitrogen use in the tropics sponsored by the Colombian Society of Soil Science and consulted with soil scientists at Palmira and the Llanos Orientales. Drs. C. B. McCants and P. A. Sanchez discussed with the

Guatemalan Ministry of Agriculture and USAID soils problems needing attention and experimental procedures in that country. CIAT invited Dr. P. A. Sanchez to present a paper on agronomic practices for new rice varieties at the recently held Seminar on Rice Policies in Latin America. Dr. Sanchez returned to Peru to make further arrangements for establishing the shifting cultivation station in the jungle and attended the annual agronomy review meeting of the National Rice Program.

The faculty of the department cooperated with the International Soil Fertility and Improvement Project in conducting its annual seminar for approximately 25 participants from tropical regions. Participation was in the form of lectures, guided tours and personal consultation

An average of three visitors per month from tropical regions are programmed through the department. These visitors generally are seeking information to aid in the understanding and management of their soils. The ability of the faculty to speak from a base of personal experience gives further weight to the impact of their consultation with these influential people.

Involvement of Other University Resources: The specific activities made possible through the 211(d) grant are interrelated with the other teaching, research, and extension programs of the department. This favorable condition results from the interaction of personnel involved in the various programs and the prevailing high level of interest among the faculty on soils of the tropics. Major interaction occurs with the following other University programs.

1. Tropical Soils Research Project (Contract No. AID/csd 2806).
Personnel involved in the 211(d) grant are also serving as project leaders

on this contract. Its major objectives are to acquire technical information related to fertilization and management of soils of the tropics with special emphasis on three major ecological regions of tropical Latin America and factors pertaining to the use of soil testing as a guide to fertilizer recommendations.

2. International Soil Fertility Evaluation and Improvement Project (Contract No. AID/1a 646). The objective of this program is to provide technical assistance in the development and operation of soil fertility evaluation and improvement programs in selected countries in Latin America including the establishment and operation of soil testing laboratories. Personnel involved in the 211(d) program are also serving as short-term consultants in the 1a 646 project.

3. Peruvian Rice Program. Dr. P. A. Sanchez, who is employed as Assistant Professor of Tropical Soils through funds provided by the 211(d) grant, is actively involved as a soils management advisor to the rice program in Peru. Prior to appointment to this position, Dr. Sanchez worked for three years as Coleader of the National Rice Program in Peru, being actively involved in rice fertilization research in the Coast and Selva regions.

4. Peruvian Potato Program. Dr. R. E. McCollum, Associate Professor in the Soil Science Department, is now and has been for six years an active consultant on soil fertility matters pertaining to the National Potato Program of Peru. He was stationed in Peru for two years with responsibility for soil fertility research on potatoes. He will become increasingly involved in other projects related to the objectives of the 211(d) grant.

5. Graduate Training. The faculty of the department is involved in programs leading to advanced degrees in Soil Science for the following students from tropical regions.

<u>Name</u>	<u>Degree</u>	<u>Country</u>	<u>Sponsor</u>
Benavides, Servio	Ph.D.	Colombia	ICETEX
Chuntanaparb, Nilprapai	M.S.	Thailand	Rockefeller
Ezeta, Fernando	Ph.D.	Peru	AID
Granger, Michael	Ph.D.	Guyana	AID
Khomvilai, Somchai	M.S.	Thailand	Thailand Govt.
Lepsch, Igo	M.S.	Brazil	Brazilian Govt.
Lugo, Hector	Ph.D.	Puerto Rico	NCSU
Manzano, Amado	M.S.	Bolivia	AID
Mendez, Jose	M.S.	Panama	AID
Soepardi, Goeswono	Ph.D.	Indonesia	AID
Tan, Keat	Ph.D.	Malaysia	NCSU
Tonapa, Sampe	Ph.D.	Indonesia	NCSU
Villagarcia, Sven	Ph.D.	Peru	Rockefeller

Personnel: The following personnel in the Soil Science Department have been actively involved in 211(d) grant related activities:

Dr. C. B. McCants, Professor and Department Head

Dr. P. A. Sanchez, Assistant Professor, Tropical Soils

Dr. W. V. Bartholomew, Professor

Dr. S. W. Buol, Professor

Dr. M. G. Cook, Professor

Dr. F. R. Cox, Associate Professor

Dr. G. A. Cummings, Associate Professor
Dr. J. W. Fitts, Professor
Mr. M. A. Granger, Graduate Student
Dr. E. J. Kamprath, Professor
Dr. J. F. Lutz, Professor
Dr. R. E. McCollum, Associate Professor
Mrs. Mary Moore, Secretary
Mrs. Patricia Patrick, Research Technician
Mr. F. T. Turner, Graduate Student
Dr. J. L. Walker, Visiting Associate Professor

Plan of Work for Next Year

Teaching: Dr. P. A. Sanchez is developing the syllabus for a graduate level course on "Properties and Management of Tropical Soils." This course will be offered annually to graduate and advanced undergraduate students. The "Colloquium on Tropical Soils", which has been conducted for several years, will be conducted again in 1972.

The content of all courses offered by the department will be analyzed further and, where appropriate, subject matter on the unique properties of tropical soils will be incorporated into the course.

Additional graduate student programs will be initiated for domestic and foreign students interested in tropical soils.

Plans are in the advance stage for Dr. John K. Coulter, who has had extensive experience in the tropics, to visit the campus as a visiting lecturer under the sponsorship of the 211(d) grant. It is our hope that arrangements can be made for Mr. Carlos Zamora of Peru and Mr. Marcelo Camargo of Brazil to also spend some time on the campus as visiting lecturers.

The extensive involvement in graduate programs involving thesis research on tropical soils will be continued and expanded. Three additional graduate programs funded by the 211(d) grant are anticipated during the year.

Research: Specific plans are being developed to initiate research on soils-related problems in the countries listed below to provide the faculty with additional knowledge and experience on properties and management of tropical soils. A portion of the work will be performed in the tropical region of the country and a portion on the Raleigh campus.

1. Guatemala: Studies on nitrogen and micronutrient fertilization in the Pacific Coast lowlands and volcanic ash highlands.
2. Colombia: A study of the composition and classification of selected soil profiles from tropical humid (rain forest) area of southeastern Colombia.
3. Panama: Correlation of soil test results with crop response to fertilizer.
4. Bolivia: Correlation of soil test results with crop response to fertilizer.
5. Peru: Studies on the properties and management of soils under shifting cultivation.
6. Brazil: Studies on the physical, chemical and nutritional problems of soils of the Camp Cerrado.

Services and Consultation: On-site visits will be made to the countries where related research will be conducted to obtain soils for intensive study, to secure background information and, where appropriate, to initiate on-site research. These activities will be closely coordinated with local soil scientists working with universities, ministries of agriculture and foundations (for example, IRRI, CIAT and CIMMYT).

Continued emphasis will be given to coordinating the activities sponsored by the 211(d) grant with those under the Tropical Soils Research Project and the 1a 646 project to insure that the expertise of the department in tropical soils is strengthened and its overall contributions to international soil science is advanced.

Plans are being developed to participate in a special seminar in Idadan, Nigeria in the spring of 1972 to discuss the identification of priority problems on soils of the tropical area of Africa. Field trips will be made to several countries in the tropical regions of Africa to gain additional on-site experience on tropical soils.

Expenditures

International Travel

Name: J. W. Fitts

Travel Points: Portugal, Spain, Japan and Hawaii

Date: January 19 - March 21, 1971

Purpose of Trip: To participate in seminars, symposiums and conferences relative to soil fertility evaluation.

Accomplishments: Advantage was taken of an assignment to India with the Ford Foundation to visit Portugal, Spain, Japan and Hawaii to become acquainted with their soil fertility evaluation programs. In Portugal, visits were made to the National Agricultural Research Station at Qeiras, the Ministry of Agriculture, and the soils laboratories at the University. In Spain, time was spent at the National Research Institute where several conferences were held with the staff relative to their research and educational programs and two seminars were presented to the

staff. The visits in Japan included the National Research Institute in Tokyo, Kyoto University in Kyoto, and the Southeast Asia Soils Research Institute in Kyoto. A seminar on soil fertility evaluation was presented at Kyoto University. A trip was made to a reclaimed area near Kyoto and also to two of their field research stations where both their field and laboratory studies were reviewed. Most of the time in Hawaii was spent at the Rice Training Center and Research Station on the island of Kauai studying the programs in progress.

Cost: \$441.20

Name: M. G. Cook

Travel Point: Puerto Rico

Date: April 11-16, 1971

Purpose of Trip: Participate in the 211(d) Executive Committee meeting, plan teaching workshop to be held in Hawaii, and study local soil characteristics.

Accomplishments: Individual professional proficiency was enhanced significantly as a result of on-site observations and discussions of soils in tropical and subtropical regions. The characteristics and usage of soils in such regions generally are in contrast to soils of temperate regions. Consequently, the knowledge gained has increased the competence to advise the large number of international undergraduate and graduate students in our department concerning their native soils problems.

Cost: \$291.20

Name: C. B. McCants

Travel Point: Puerto Rico

Date: April 11-16, 1971

Purpose of Trip: To attend Executive Committee meeting of 211(d) Consortium and visit soils research sites in Puerto Rico.

Accomplishments: Plans were initiated for the Tropical Soils Teaching Workshop held in Hawaii in July and other business matters pertaining to the Consortium were discussed with other members of the Executive Committee. Plans for the next meeting of the Executive Committee were made. Visits to research stations and examination of soil profiles and management systems contributed to an improvement in knowledge and understanding of the soils of Puerto Rico which is useful in consideration on other soils of the tropics.

Cost: \$325.95

Name: W. V. Bartholomew

Travel Points: Thailand and the Phillipines

Date: February 19-25, 1971

Purpose of Trip: To observe and review soil fertility problems and research in Thailand and the Phillipines and to study organization of short-time training at the International Rice Research Institute.

Accomplishments: A study was made of the management of the flat, poorly drained aluvial soils along the rivers. They are referred to as cat clays with subsoils containing sulfides. The methods in use involve construction of shallow surface drains to remove surface water and permit the topsoil to stay aerobic but keep the subsoils anaerobic and

in a reduced state of oxidation. Information was obtained on management experiments in progress at the International Rice Research Institute at Las Ranos, the Phillipines. Included in this study are systems which permit the year-round production of crops on a given site. Studies were also made on the training procedures used by the Institute for professional and subprofessional personnel.

Cost: \$163.19

Name: S. W. Buol

Travel Point: Peru

Date: May 26 - June 4, 1971

Purpose of Trip: Locate representative sites for soil experiments in the selva region and develop personal contacts with Peruvian soil survey personnel to attain a better working knowledge of humid tropical soils.

Accomplishments: The trip provided a valuable opportunity to merge soil fertility and soil survey experience and data. During the trip, Peruvian agronomos provided a demonstration of how these disciplines can cooperate. A very suitable site was established for a research station to be used by the Peruvian government and it was decided that the site selected also had great potential as a "field station" to train graduate students in shifting cultivation problems of forested tropical soils.

Cost: \$731.56

Name: M. G. Cook

Travel Point: Hawaii

Date: July 7-25, 1971

Purpose of Trip: To represent North Carolina State University in the Tropical Soils Teaching Workshop sponsored by the Consortium.

Accomplishments: Additional professional proficiency was obtained as a result of on-site observations and discussions of soils in this tropical region. During the workshop, profitable discussions were held with representatives of the member institutions of the Consortium concerning the dissemination of soils information peculiar to tropical regions. The information and procedures are being incorporated into our present courses.

Cost: \$716.25

Name: S. W. Buol

Travel Point: Guyana

Date: August 8-22, 1971

Purpose of Trip: To work with graduate student (Michael A. Granger) to obtain soil samples for use in his Ph.D. research program. The sampling sites were studied to provide a field evaluation for interpretation of the laboratory results.

Accomplishments: The trip yielded samples from two major soil types extensively used in agriculture in the coastal plains of Guyana for experimentation in the course of Mr. Granger's thesis. The experience also provided an opportunity to observe water control measures in sugar cane production on acid sulfate "cat clay" soils. A seminar was presented for the research workers at Mon Repos.

Cost: \$527.01

Name: Michael A. Granger

Travel Point: Guyana

Date: August 10-23, 1971

Purpose of Trip: To collect samples for use in Ph.D. research and to study sampling area to provide a field evaluation for interpretation of analyses of samples.

Accomplishments: The samples required for the thesis research were taken and characterization data obtained on the sample sites. A study was made of the agricultural situation in the country with respect to those aspects that relate to the professional training program. This information is useful in guiding modifications in the graduate program to make it more relevant to tropical soil conditions.

Cost: \$624.76

Name: P. A. Sanchez

Travel Points: Colombia and Guatemala

Date: August 29 - September 11, 1971

Purpose of Trip: To present a paper and participate in the meetings of the Colombian Society of Soil Scientists; to visit experimental sites in Colombia and to discuss with Colombian soil scientists matter of mutual interest on the characteristics, fertilization and management of tropical soils; to visit agricultural regions in Guatemala and consult with Guatemalan soil scientists and AID mission personnel.

Accomplishments: The paper "Nitrogen Fertilization of Rice" was presented at the Colombian Society of Soil Scientists and numerous informal discussions were held with various participants at the meeting. Visits were made to CIAT headquarters at Palmira and to the CIAT-ICA

experimental area at Carimagua in the Llanos Orientales. At each site, discussions were held with project leaders on the objectives, accomplishments and problems encountered in their research. In Guatemala, conferences were held with local soil scientists, the regional director of NCSU's International Soil Fertility Evaluation and Improvement Program and local AID mission personnel. Tentative plans were developed to involve personnel from the Ministry of Agriculture, the agronomy faculty of the University, and the local mission in 211(d) related activities of North Carolina State University.

Cost: \$718.26

Name: C. B. McCants

Travel Points: Colombia and Guatemala

Date: August 28 - September 8, 1971

Purpose of Trip: (1) To present paper and participate in the meeting of the Colombian Society of Soil Scientists; (2) to visit experimental sites in Colombia and discuss with Colombian soil scientists matters of mutual interest on the characteristics, fertilization and management of tropical soils; and (3) consult with Guatemalan soil scientists and AID mission personnel on soils related problems.

Accomplishments: A paper "Nitrogen Movement in Soils" was presented at the Colombian Society of Soil Scientists and numerous informal discussions were held during the course of the colloquium with a substantial number of people attending the meeting. Visits were made to the CIAT headquarters and field sites at Palmira and to the CIAT-ICA experimental area at Carimagua in the Llanos Orientales. At each place, discussions

were held with project leaders on the objectives, accomplishments and problems encountered in their research. In Guatemala, conferences were held with local soil scientists, the regional director of NCSU's International Soil Fertility Evaluation and Improvement Program and the local AID mission personnel. Tentative plans were developed to involve personnel from the ministry of agriculture, the agronomy faculty of the University and the local AID mission in 211(d) related activities of North Carolina State University.

Cost: \$690.14

Other Expenditures

Salaries and Wages	\$5,799.80
Fringe Benefits	79.91
Travel, Domestic	55.20
Telephone Service	156.06
Transportation of Soil Samples	69.60
Supplies	19.79

Budget

Summary of 1970-71 expenditures and projected expenditures for remainder of grant period.

	1970- 1971	1971- 1972	1972- 1973	1973- 1974	1974- 1975
Salaries and Wages, Total	5,800	73,905	87,568	92,075	103,282
Eligible for fringe benefits	1,075	40,973	45,070	49,577	54,535
Visiting professors	0	8,332	12,498	12,498	18,747
Graduate assistants	4,725	21,600	27,000	27,000	27,000
Subprofessional assistance	0	3,000	3,000	3,000	3,000
Fringe Benefits	80	5,818	6,400	7,040	7,744
Travel, Total	5,304	14,000	17,000	19,000	19,000
Faculty, international	4,604	12,000	12,000	12,000	12,000
Faculty, national	55	1,000	1,000	1,000	1,000
Graduate students, inter- national	645	1,000	4,000	6,000	6,000
Communications	156	600	800	800	800
Contractual	70	1,000	2,500	3,000	3,000
Supplies	20	2,294	3,722	3,094	2,128
Equipment	0	4,000	3,000	3,000	3,000
TOTAL	11,430	101,617	120,990	128,009	137,954

REPORT OF
UNIVERSITY OF PUERTO RICO

UNIVERSITY OF PUERTO RICO

SUMMARY

The main contribution of Section 211(d) of the total University of Puerto Rico capability in the teaching and related research in tropical soil science for increased food production can be best understood if the situation prior to the grant is fully visualized. The established policy in the institution was to divide the staff members into two groups: those in full time research and those engaged in full time teaching. Those assigned to research were under the jurisdiction of the Agricultural Experiment Station and as such did not participate in any matters related to teaching. Those assigned to full time teaching were required to devote 12 to 15 hours of classroom contact with the students, the laboratory periods to be counted as half time. Under this type of arrangement the staff members assigned to teaching could not possibly engage in research. As of today and as a direct result of 211(d), the teaching load has been lowered and all staff members engaged in the teaching of soils are doing some type of research. This has been possible by the appointment of two additional staff members, and a graduate assistant through 211(d) funds as described in the proposal.

An important item, intimately related to the objective of the program, is the Institution's capability to conduct research in tropical soils and to participate in technical assistance programs. Both are indispensable adjuncts of effective training committed to the productive use of tropical soils.

At this stage we can provide expertise in Tropical Soils Management and Tropical Soils Genesis and Classification to any Institution so desiring.

To implement the objectives of the program at the campus level the following provisions have been taken:

1. Provide a senior faculty member to serve as the University of Puerto Rico project leader.
2. Provide visiting professorships through which Puerto Rico can bring in special competencies either from the cooperating institutions or from other sources.
3. Provide an additional junior staff member so as to develop specialization within the staff on the different areas of Soil Science pertaining to Protection and Conservation.
4. Provide financial support to graduate students contributing to this project.
5. Provide financial support for travel of contributing staff members.
6. Revise, modify and develop new courses in tropical soils.
7. Strengthen library and other informational services and provide for the preparation of training aids pertinent to the project.

To implement the joint effort of the cooperative program, the following provisions have been taken:

1. Appoint a senior faculty member to coordinate our efforts with those of other participating institutions, and to provide policy and program guidance.
2. Reinforce existing competency by recruiting and appointing a resident junior staff member.
3. Make available our physical resources, as well as our existing staff competencies, to the other cooperating institutions through the development of joint education and/or research projects on tropical soils.

OBJECTIVES

The major objective of this program is to increase the capability of the Mayaguez Campus of the University of Puerto Rico to provide education and training in the utilization of the soils of the tropics; in a joint effort with the University of Hawaii, North Carolina State University, Cornell University and Prairie View A & M College. The primary focus would be on the soils of the humid tropics and how they might be most effectively utilized for sustained and profitable food production. As an essential component of meaningful education and training the program includes supporting studies in applications of meteorology, the plant sciences, the animal sciences, and the social sciences to the tropical environment.

This objective requires and is getting inputs from at least four areas of soil science: (a) the study, characterization, and classification of tropical soils; (b) plant nutrient requirements for the production of food crops on humid tropical soils; (c) soil-water-plant relationships under humid tropical conditions; and (d) management practices for the conservation and protection of tropical soils for sustained crop production.

ACCOMPLISHMENTS TO DATE

Although the grant was accepted by the proper university authorities and the funds were available as of March 4, 1971 it was not until the middle of July that the Mayaguez Campus was duly notified by the University of Puerto Rico president's office.

Teaching: Since the initiation of the proposals, Prof. Rafael Pietri, Professor of Soil Science, has been in charge of all the activities. He was appointed to serve on the Executive Committee of the Consortium to coordinate

our efforts with those of other participating institutions. He has been acting as secretary of the Committee and organized the Executive Committee meeting that was held in Puerto Rico during April 12-16, 1971, all institutions attending. When the grant became effective he was appointed project leader and he will be responsible in furthering the purposes of the grant.

Contacts have been made with Dr. H. W. Fassbender, a distinguished soil chemist with a broad background of experience in the tropics, specially the American tropics, and Dr. W. D. Schrader, Professor of Soil Management and Conservation, Iowa State University and we expect to have them with us for some time during next year.

Since the initiation of the proposal, which called for the addition of a junior staff member (an instrumental analysis specialist) the administration of the College of Agricultural Sciences was approached and asked for funds to appoint in advance this new member. Funds were made available from the Dean's office and matched with funds from the Dean of Studies Office. Miss Milagros Miro was appointed as of August, 1970. As the funds made available were only for one year Miss Miro is now under 211(d) grant funding, as originally planned.

As of July 1, 1971, Dr. Fred H. Beinroth has been incorporated to our staff as Associate Professor in Soils. Dr. Beinroth will be teaching a course in Soil Genesis, Classification and Morphology and the course Soils of Puerto Rico, and conducting research on Soil Genesis and Classification as project leader.

One graduate student is currently getting financial support under the grant. He is an M.S. candidate. He takes care of the laboratory work of the general soils course.

Dr. Fred H. Beinroth, appointed under the grant, is currently revising the course on Soil Genesis, Classification and Morphology and the course on Soils of Puerto Rico.

Dr. Miguel A. Lugo described two new courses on Soils Management. One is a course on "Topics in Management of Tropical Soils" and is designed to teach the student to apply the principles of soil science in the interpretation and use of recent research relating to problems in the management and protection of tropical soils. The other course "Management of Tropical Soils" deals with the application of the principles of soil science in designing and evaluating management systems for tropical soils.

Miss Milagros Miro described a course in "Instrumental Analysis of Soils and Plants." The course is designed to familiarize the student with the latest instruments and their use in soil and plant analysis.

Dr. Fred H. Beinroth visited Hawaii to participate in the 211(d) Soils Teaching Workshop. During the workshop he submitted reports on: (A) Soil Formation in the Tropics, (b) Soil Classification with Special Consideration for the Tropics, and (c) Soil Formation, Concepts and Instructional Objectives.

From September 7 through 13, 1971, Dr. Beinroth attended the Joint Meeting of Commissions V and VI of the ISSS at the University of Hohenheim near Stuttgart, Germany. The meeting focused on hydromorphic soils, their formation and utilization.

Research: In an effort to procure the data required to initiate a research project, on the correlation of soil taxonomic units a visit was paid to the FAO Headquarters in Rome, Italy. Owing to the excellent cooperation of Dr. R. Dudal, Chief, Soil Resources, Development and Conservation, and Dr. A. J. Pecrot, Senior Officer and Soil Correlator, much of the information needed

was obtained. At the same time the discussions revealed, however, that some difficulties will be encountered in achieving the objectives as outlined in the project proposal.

No thorough evaluation of the data compiled could be done at this time. The brief account that follows merely summarizes the general results of the FAO visit and points out the ensuing position of our project:

1. With the partial exception of WSRR 33, all previous FAO publications pertaining to soil units of the soil map of the world are obsolete.
2. The FAO/UNESCO world-wide legend has been finalized and compiled in an unpublished FAO report (AGL:SM/70/2-WS/A7460). There now are 103 soil units which are grouped into 26 higher categories. (See attached copy). At this stage definitions have not been written up in full, but there is a key which supplies sufficient information for high-level placement.
3. The soil units advanced in WSRR 33 have undergone revision and considerable modification. However, most of the definitions remained essentially unchanged, except for nomenclature. The definitions for FAO diagnostic horizons correspond closely to those of Soil Taxonomy.
4. The FAO/UNESCO legend is not a classification system. Rather, it is a compilation of world-wide correlated and defined soil units that were grouped into 26 higher categories in recognition of important soil regions of the world rather than taxonomic grounds.

The FAO nomenclature is heterogenous. Many names were adopted from current soils literature (e.g. Vertisols, Podzols, Ranker), but in addition some new names were coined (e.g. Acrisols, Luvisols, Nitosols).

5. FAO units represent different levels of generalization as they do not strictly adhere to taxonomic rules.
6. The definitions of FAO units are, by necessity, comparatively broad and correspond, in general, with USDA Suborders and in some cases Great Groups. A comparison of the two Schemes demonstrated this point:

<u>FAO/UNESCO</u>	<u>USDA</u>
26 high categories	10 Orders
103 units	43 Suborders
	200 Great Groups

In view of these facts, the prospects for our correlation project appear to be as follows:

1. Most FAO units will have several USDA correlatives, both at the Suborder and at the Great Group level.
Thus, an Acric Ferralsol may be an Acrohumox, an Acrorthox or an Acrustox.
2. USDA Suborders can likely be correlated with reasonable accuracy, while it will be impossible to meaningfully match some Great Groups with FAO units.
3. Due to the nature of the two schemes which are based on two divergent rationales, their correlation cannot be achieved in a consistent manner as regards the level of correlation.
4. It is anticipated that correlation tables will materialize from this project which in spite of their inherent shortcomings will largely meet the objectives forwarded in the project proposal.

Other research projects on the nutritional level requirements of edible legumes and vegetables are underway. A full report on the outcome will be presented next year.

EXPENDITURES

	<u>Up to Aug. 31, 1971</u>	<u>Projection to March 1, 1972</u>
Salaries	\$ 3,191.66	\$ 12,851.64
Wages	483.81	733.19
Travel & Subsistence	1,271.60	3,023.74
Supplies & Materials	20.00	413.32
Departmental Support	<u>249.00</u>	<u>2,847.95</u>
Total	\$ 5,216.07	\$ 19,869.84

International Travel: Dr. Fred H. Beinroth attended in Germany the meeting of Commissions V and VI of ISSS. On this same trip he visited the FAO/UNESCO Offices in Rome to discuss with them the research project on the correlation of the FAO soil units with the USDA systems. Preliminary contacts were made for our Visiting Professors Program. The trip was from September 7 to 23, 1971.

Equipment Purchased: Air conditioning unit 18,000 BTU, Fedders for Room P-113 that is being prepared as office of the project leader -- \$249.99.

WORK PLAN

Plans for 1971-72 include the following:

1. Preliminary plans have been made for a Tropical Soils Institute to be held in Puerto Rico in June-July, 1972.

This will be an intensive training for professionals in Soil Science and will carry graduate credit. The Institute will have inputs from Consortium members.

2. A number of research projects are being prepared to be carried out under the 211(d) grant.
 - a. Correlation of FAO/UNESCO Soil Units with the USDA Soil Taxonomy System.
 - b. Correlation of the Soils of Puerto Rico with Soils of South America.
 - c. Comparative Geomorphic-Pedogenetic Study of Oxisols and Ultisols from Puerto Rico and Hawaii.
 - d. Evaluation of Mineralogy Classes Relative to Soil Management for Oxisols and Ultisols from Hawaii and Puerto Rico.
 - e. Visual Aids for Major Soils of Puerto Rico.
 - f. The response of P. vulgaris and V. sinensis to different levels of nutrition of Coto clay.
 - g. The effect of different nutrient levels on the yield and agronomic characteristics of root crops in Coto clay and Humatas clay.
3. A close collaboration has been initiated with the University of Hawaii, and will be continued mainly through the research projects.
4. Each of the other collaborating institutions will be visited to obtain first hand knowledge of their programs and to investigate potential exchange or transfer of students.

5. An intensive campaign will be carried out to recruit more graduate students.
6. A junior staff member will be recruited in the area of soil fertility and fertilizers.

Budget Next Year

Salaries -----	\$ 73,792.00
Stipends -----	21,600.00
Supplies & Materials -----	7,100.00
Departmental Support -----	9,230.00

For the next three year - \$120,000.00 per year.