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## REPORT OF UNIVERSITY OF PUERTO RICO

For the Period

July 1, 1972 to June 30, 1973

A. TITLE: A Grant to Strengthen the Capabilities of the University of Puerto Rico in Special Problems of Tropical Soils.

B. GRANTEE: University of Puerto Rico

C. DIRECTOR: Professor Rafael Pietri Oms

D. STATISTICAL SUMMARY:

1. Period of Grant: March 4, 1971 to March 3, 1976

2. Amount of Grant: \$ 500,000

3. Expenditures:

3.1 For report year: \$ 126,392.96

3.2 Accumulated: \$ 203,876.76

3.3 Anticipated for next year: \$ 108,677.33

E. NARRATIVE SUMMARY:

The main contribution of the Grant under Section 211(d) to the total capability of the University of Puerto Rico in the teaching and related research in tropical soil science for increased food production can best be understood if the conditions prior to the grant are fully visualized. The established policy in the institution was to divide the staff members into two groups: those engaged 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 from 12 to 15 credit hours of classroom work per week in direct contact with 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), 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 three graduate assistants 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.

4. Provide a junior staff member "half-time" financed by the Agricultural Experiment Station as Co-Leader in the root crops research projects.
5. Provide financial support to graduate students contributing to this project.
6. Provide financial support for travel of contributing staff members.
7. Revise, modify, and develop new courses in tropical soils.
8. 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. This professor serves also as project leader.
2. Reinforce existing competency by recruiting and appointing 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.

## F. DETAILED REPORT

### I. General Background and Purpose of the Grant

A Grant by AID would expand and strengthen the existing competencies of the University of Puerto Rico, Cornell University, the University of Hawaii, North Carolina State University, and Prairie View A&M College in tropical soils. These Grants are to establish a collaborative program among these universities to develop special competencies, to provide such services as training, research, technical assistance and consultation in soil science for increasing food and fiber production on tropical soils.

The individual Grants will strengthen the following areas:

<u>Institutions</u>	<u>Field of Concentration</u>
1. Cornell University	Tropical Soils Cultural Systems
2. North Carolina State University	Soil Fertility Relating Plant Nutrition to the Physical and Chemical Properties of Tropical Soils.
3. Prairie View A&M College	Soil Fertility Problems under Savanna-Prairie Ecology
4. University of Hawaii	Biology and Mineralogy of Tropical Soils

The five universities already have institutional commitments to agricultural programs for developing nations and each has an interest in developing greater depth in their tropical soils capability. The five universities collectively represent a broad spectrum of ecological interests ranging from the Oxisols of Hawaii to the prairie soils of Texas and the highly weathered soils of North Carolina and Puerto Rico. They represent a range of specialities and interests that complement each other so well that major facets of tropical soils are covered. Therefore, by

considering the five universities as a coordinated group, an effective critical mean is achieved in building the United States competence in tropical soils.

The University of Puerto Rico has long experience with production of food and forage crops on tropical soils and in soil conservation and management. It is Latin America oriented in culture and language.

## II. Objectives of the Grant

### 1. Objectives Restated

To implement the joint programs, each institution will:

1. Appoint a representative in a position of administrative responsibility to a program council whose function will be to provide policy and program guidance.
2. Appoint a project leader who will serve on a program executive committee, which will develop detailed plans of cooperation.
3. Reinforce existing competencies by appointment of resident and visiting staff in areas that will complement existing strengths of the five institutions.
4. Provide for support of students and faculty including exchanges of students and faculty to capitalize on the respective strengths of the cooperating institutions.
5. Make available physical resources, including office space, laboratories, equipment, and other facilities

and services, as well as existing staff competencies as the institution's contributions.

6. Develop a viable educational and research project on tropical soils and accommodate requests for training, technical assistance and consulting services as feasible and consistent with institutional resources and commitments.

## 2. Review of 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 protection and conservation 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 and protected 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.

An important and intimately related objective is to increase the Institution's capacity to conduct research in tropical soils and participate in technical assistance programs involving utilization of tropical soils.

Both are necessary adjuncts of effective training for professional manpower committed to productive use and conservation of tropical soils and are, in addition, compelling ends in themselves consistent with the service to AID which is in Section 211(d) of the Foreign Assistance Act of 1966.

This objective requires and will be 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.

### III. Accomplishments

Teaching. Since the initiation of the proposals, Professor Rafael Pietri, Professor of Soil Science, has been in charge of all 211(d) 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 has been elected chairman for F/Y 1972-1973. When the grant became effective he was appointed project leader and will be responsible in furthering the purposes of the grant.

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 this new member. Funds were made available

and Miss Milagros Miro was appointed as of August, 1970. As the funds were made available for only one year, Miss Miro is now under 211(d) grant funding, as originally planned, and will continue to be for the duration of the grant.

Miss Milagros Miro described a new course in "Instrumental Analysis of Soils and Plants." The course is designated to familiarize the student with the latest instruments and their use in soil and plant analysis and was offered for the first time in the spring semester of the 1972-1973 academic year.

A significant new feature in the advanced undergraduate instruction has been the new approach given to the course "Special Problems in Soils" since the academic year 1971-1972. With the appointment of Miss Miro, this course has been geared toward exposing advanced undergraduate students to simple research problems. Five students during the fall semester and three during the spring term were involved in this type of academic activity. The topics were the following.

- 1) A comparative study of the extraction methods used in geochemistry.
- 2) A comparison of instrumental methods for fertilizer analysis.
- 3) Cation exchange capacity as affected by different parameters.
- 4) The distribution of macronutrients around the rhizosphere of *Dioscorea* sp.
- 5) Phosphorus adsorption curves of some Oxisols under different agronomic field practices.

Since July 1, 1971, Dr. Fred H. Beinroth has been in our staff as Associate Professor in Soils. Dr. Beinroth is revising and will be teaching

the course Soil Genesis, Classification and Morphology; the course Soils of Puerto Rico, and will also be conducting research on Soil Genesis and Classification as project leader.

During F/Y 1972-1973, Dr. Beinroth offered the courses on "Genesis Morphology and Classification of Soils" and "Soils of Puerto Rico." He coordinated the section on Soil Genesis and Geomorphology together with Dr. M. G. Cline, Cornell University for the Tropical Soils Institute and was in charge of the preparation and guidance of the field trips.

Dr. Hector Lugo Mercado who was working toward his Ph.D. at North Carolina State University was re-incorporated to our staff on a full-time basis. He revised and offered a new course on "Mineral Nutrition of Plants."

A Tropical Soils Institute was organized for the summer of F/Y 1972-1973, July 1972. The Institute offered intensive instruction in the application of current knowledge of soil science and related disciplines to problems of crop production in the tropics. It was an institute for professional soil scientists, both from the U. S. and international, holding B.S. or higher degrees and carrying four credit hours of graduate work.

A faculty recruited from the five institutions were guest lecturers:

Dr. Goro Uehara  
Dept. of Agronomy & Soil Science  
University of Hawaii  
2525 Varney Circle  
Honolulu, Hawaii

Dr. Modesto Capiel  
Department of Agronomy Soils  
Agricultural Experiment Station  
P. O. Box H  
Rio Piedrad, Puerto Rico 00928

Dr. M. G. Cline  
Department of Agronomy  
Bradfield Hall  
Cornell University  
Ithaca, New York 14850

Dr. S. W. Buol  
Department of Soil Science  
North Carolina State University  
Box 5907  
Raleigh, North Carolina 27607

Dr. R. L. Fox  
 Dept. of Agronomy & Soil Science  
 University of Hawaii  
 2525 Varney Circle  
 Honolulu, Hawaii 96822

Dr. Douglas J. Lathwell  
 Department of Agronomy  
 Bradfield Hall  
 Cornell University  
 Ithaca, New York 14850

Dr. D. R. Bouldin  
 Department of Agronomy  
 Bradfield & Emerson Halls  
 Cornell University  
 Ithaca, New York 14850

Sr. Fernando Abruña  
 Department of Agronomy  
 Agricultural Experiment Station  
 P. O. Box H  
 Rio Piedras, Puerto Rico 00928

Dr. F. H. Beinroth  
 College of Agricultural Sciences  
 Department of Agronomy  
 University of Puerto Rico  
 Mayaguez, Puerto Rico 00708

Dr. Eugene Brams  
 Associate Professor of Soil  
 Science  
 School of Agriculture  
 Prairie View, Texas 77445

Dr. Pedro A. Sanchez  
 Department of Soil Science  
 North Carolina State University  
 Raleigh, North Carolina 27607

Sr. Jose Vicente  
 Department of Agronomy  
 Agricultural Experiment Station  
 P. O. Box H  
 Rio Piedras, Puerto Rico 00928

Dr. M. Weaver  
 Department of Agronomy  
 Emerson & Bradfield Halls  
 Cornell University  
 Ithaca, New York 14850

Dr. Eugene Kamprath  
 Department of Soil Science  
 North Carolina State University  
 Raleigh, North Carolina 27607

Four areas of study were covered, namely:

1. Soil Genesis, Geomorphology, Classification, and Climatology under the responsibility of Dr. Fred H. Beinroth, University of Puerto Rico.
2. Soil Physics and Mineralogy, under the responsibility of Dr. Goro Uehara, University of Hawaii.
3. Soil Chemistry and Fertility under the responsibility of Dr. D. R. Bouldin, Cornell University.

4. Soil Management Systems under the responsibility of Dr.  
P. A. Sanchez, North Carolina State University.

Each section met daily during four days of the week for a 60 minute lecture and a 30 minute discussion period, during four consecutive weeks. Two weekly field trips offered the opportunity to the participants to visit all the ecological areas on the island.

Applications for admission were received from 36 students from the following areas: Venezuela, Chile, Sierra Leona, Brazil, Haiti, Ethiopia, Colombia, Panama, India, Uganda, Peru, Dominican Republic, Guatemala, Paraguay, El Salvador, Indonesia, U. S. Mainland, and Puerto Rico.

Twenty-six attended.

During F/Y 1972-1973, two distinguished soil scientists visited the Mayaguez campus: Dr. A. Van Wambeke, University of Ghent, Belgium and Dr. H. W. Fassbender, University of Gottingen, Germany.

While visiting Professor at the College of Agriculture, Dr. Van Wambeke concentrated his activities mainly on the following topics:

- Four seminars on various aspects of tropical Soils of South America (at the College of Agriculture)
- One seminar on management of Oxisols of South America (at the Agricultural Experiment Station, Rio Piedras)
- Correspondence of selected soils of Puerto Rico with those of South America
- Review of the proposal on soil classification submitted to AID
- Review of papers presented during the pedology session of the seminar on Savanna Soils

- Correlation of the French Soil Classification System with the USDA and FAO schemes
- Compilation of lists of soil scientists that
  - a) are useful contacts in South America
  - b) work on savanna soils in Africa
  - c) could serve as consultants to AID

While at Mayaguez, Dr. Fassbender offered seven lectures as part of the Agronomy Seminar. The following topics were covered:

- 1) Physo-chemical evaluation of the soil phosphorus
- 2) Chemical nature of phosphorus fixation
- 3) Cationic equilibria in tropical soils
- 4) Liming effects on the exchange complex in tropical soils
- 5) Liming factors in nitrogen fixation in the tropics
- 6) Manganese equilibria in soils of Central America
- 7) Translocation of nutritive elements in tropical soils

In addition, Dr. Fassbender was available for consultation by students, staff members, and researchers from the Agricultural Experiment Station.

Preliminary arrangements have been made for several distinguished soil scientists to be on the Mayaguez Campus during the coming year.

Additional equipment has been bought, installed and is already in operation for the preparation of audio visual and auto tutorial teaching aids. Audio visual techniques will be introduced in as many courses as possible. We are equipped to prepare and provide resource materials on different aspects of soil science and of tropical agriculture.

A great amount of interest has been generated among the undergraduate students in soil science because of our involvement in the 211(d) program. As a result of it, we have for the 1972-1973 academic year, local graduate students in soil science for the first time. In addition the number of graduate students increased from one to three and we expect to have six for F/Y 1973-1974.

The University of Puerto Rico participated on a Soils Workshop held at Prairie View, Texas on October 2-6, 1972 with all consortium members cooperating. Professor R. Pietri presented a paper "Changing Patterns in Land Use." The Proceedings were published at Prairie View as Bulletin No. 2 soils of the Tropics.

A Symposium of Soils of the Savanna was developed by Prairie View A&M and the University of Puerto Rico and coordinated through the efforts of Dr. James I. Kirkwood (Prairie View) and Professor R. Pietri (University of Puerto Rico). The Symposium was held in Santo Domingo, Dominican Republic and given in Spanish. Participants included:

Dr. F. H. Beinroth	Pedology	Univ. of Puerto Rico
Dr. Ildefonso Pla	Soil Management	Instituto de Edafologia Venezuela, Venezuela
Professor R. Pietri	Moderator	Univ. of Puerto Rico
Dr. José Alfaro	Water Management	Utah State Univeristy
Dr. A. Van Wambeke	Pedology	Visiting Scientist Univ. of Puerto Rico
Dr. Robert Fox	Soil Fertility	Univ. of Hawaii

Ing. Agron C. Scherer	Soil Fertility	Estación Experimental de Arroz, Brazil
Mr. Robert Cheaney	Soil Fertility	CIAT, Cali, Colombia
Dr. G. Samuels	Moderator	Univ. of Puerto Rico
Dr. F. H. Redman	Soil Fertility	Consejo Estatal del Asucar, Dominican Republic
Dr. E. Bornemisza	Soil Fertility	IICA, Lima, Peru

Publication of the proceedings is scheduled for Fall, 1973.

At the termination of the Symposium on Soils of the Savanna (see above) a committee was established to coordinate the creation of a Commission for Soil Studies of Savanna Areas of the World. The committee was chosen from members of the symposium and given the responsibility to contact scientists working in savannas from diverse geographical areas. The geographical areas were allocated as follows:

Africa	Dr. F. Beinroth and Dr. E. A. Brams
Central America and Caribbean	Dr. R. Pietri and Dr. J. B. Collins
South America	Dr. I. Pla and Mr. Y. P. Chang
Asia and Oceania	Dr. J. I. Kirkwood
Australia	Dr. J. Alfaro and Dr. H. C. Humphrey

New books and publications as well as teaching aids have been continuously acquired during the year to increase the collections in the Agronomy Department.

Research. During F/Y 1972-1973 research of three graduate students was totally or partially funded under the 211(d) grant.

1. Mr. Ricardo Barahona is a native of El Salvador, Central America. The objective of his research is to evaluate the utilization of the nutrient elements by the yam (*Dioscorea* sp.). This problem is part of the research on root crops in an effort to evaluate the full potential of this neglected food crop. Mr. Barahona holds a Graduate Assistantship funded by 211(d).
2. Mr. J. E. Jordan is a native of Puerto Rico majoring in Horticultural Crops. The objective of his research is to evaluate the effect of different levels of N-P-K-and minor elements, planting distance and planting season on the yield and quality of cabbage. The information obtained will be used in an effort to evaluate the use of tissue analysis and soil tests as diagnostic tools in cabbage fertilization in Oxisols. This research thesis is funded under the 211(d) grant.
3. Mr. Jose E. Ramirez is a native of the Dominican Republic. The objective of his research is to study the effect of the most common agronomic practices on the properties on an Oxisol (Coto clay).

Although the University of Puerto Rico does not have a research contract, staff members are actively engaged in research funded by 211(d).

Research projects on the nutritional level requirements of tropical food crops were continued during F/Y 1972-1973. Two groups of plants were used: (1) edible legumes which included field beans and cow peas; and (2) root crops which includes yams (*Dioscorea* sp.) taniens (*Xanthosoma* sp.) and cassava (*Manihot* sp.). The objective is twofold: (a) to determine the response of varieties or cultivars of these crops to maximum fertilizer

applications and/or (b) to determine the lack of response of any varieties or cultivars, thus providing a crop which could be grown under primitive farming systems without the need of complex technological inputs. This work is being done in the two principal tropical soil orders Oxisols and Ultisols.

Pigeon peas, field beans, and cow peas trials for F/Y 1971-1972 have already been harvested and the data is being analyzed. Full reports are expected to be published during the coming year after residual effects have been studied. The yams, taro, and cassava trials were harvested during the months of October and November, 1972. Complete data and full reports will be available for next year after residual effects and plant chemical composition have been studied.

A field trial of the nutritional requirements of field beans and corn was completed during F/Y 1971-1972 on a plot simulating severe sheet erosion. The top-soil and part of the subsoil was removed during land level trials and the area was abandoned after several crop failures. After a number of pot experiments a field trial was set up which included heavy phosphorus treatments and Zn treatments. The response was dramatic and the field was harvested June, 1972. A new planting was made for F/Y 1972-1973 to evaluate residual effects of the applied nutrient elements.

A research project on the characterization of the clay fraction from tropical soils by differential dissolution, X-ray, and DTA was started during F/Y 1972-1973. The objective is to evaluate the suitability of differential dissolution techniques in the determination of non-crystalline

clay components from tropical soils and to search for modifications that might improve the efficiency of separating the amorphous from the crystalline clay particles. A research project to evaluate the effect of soil compaction on the development of underground storage plant organs was initiated during F/Y 1972-1973. The objective is to determine the resistance of tropical root crops (*Dioscorea* sp., *Xanthosoma* sp.) to soil compaction.

As a result of the activities since the beginning of the grant, the following publications have been prepared:

1. The Natural Environment of Puerto Rico. University of Puerto Rico, CAAM, 30 pp. (mimeo), July, 1972.
2. Field Guide to the Soils of Puerto Rico. University of Puerto Rico, CAAM, 120 pp. (mimeo), July, 1972.
3. Classification of the Soils of Hawaii in Different Classification Systems. Manuscript prepared, 20 pp.
4. Soil-Geomorphic Relations on Kauai, Hawaii. Co-authored by G. Uehara and H. Ikawa. Submitted for publications to Soil Sci. Amer. Proc., 15 pp.
5. General Pedology of Tropical Savanna. Submitted for publication in Transactions of Seminar on Soils Tropical Savannas, 15 pp.
6. Pedologic, Mineralogic, and Chemical Properties of Highly Weathered Soils of Puerto Rico. Part I: Morphology, Formation, and Classification. Manuscript completed, 127 pp., 1 figure, 8 tables.
7. Changing Patterns in Land Use. Submitted for publication in Proceedings of Soil Workshop, Prairie View A&M, 42 pp.

#### IV. Impact of Grant Supported Activities in Developing Institutional Capabilities.

The grant supported activities are considered an integral part of the overall effort of the Department of Agronomy. As a consequence everybody feels the urge to contribute to the grant program regardless of the source of individual funding.

The main impact has been a result of the opportunity of having a research component among the duties of the staff. This effect was sensed early at the beginning and promoted us to assign a higher priority to research than was anticipated.

The response has been astonishing. The advance undergraduate students got caught on the tide with highly significant results. So far and since the establishment of the graduate school, no local student has been involved in graduate work in soil science. We have never had more than one graduate student at a time in Soil Science. The second semester of the 1971-1972 academic year saw our second student coming in. For the 1972-1973 academic year we have our first local graduate student and for 1973-1974, we expect to have a total of six.

#### V. Utilization of Institutional Resources in Development

The college of Agricultural Sciences through its Office of International Programs shares and makes available to other institutions its staff competencies and its physical resources. As part of this resource sharing, commitments have been made to provide technical assistance and training to less developed countries.

##### 1. AID/ROCAP-83 Contract

This contract calls for the graduate training in Puerto Rico of personnel from Central American Universities. Twelve participants were in Puerto Rico during the 1971-1972 academic year from four different areas: Costa Rica, Nicaragua, Guatemala, and Honduras.

Another phase of the contract calls for our sending visiting professors to these same areas. During the 1972-1973 academic year, the following staff members were on this assignment:

    José R. Mondoñedo - Universidad de San Carlos, Guatemala

    Alberto Febre - Universidad de San Carlos, Guatemala

    Francisco Jordán - Universidad de Nicaragua

    Jesús Vélez - Universidad de Honduras

2. Instituto Superior de Agricultura (ISA) Santiago, Dominican Republic.

A general contract with ISA calls for staff sharing for teaching and research supervision in any of the fields related to agriculture, at their request. During the 1971-1972 academic year, Saulo Rodriguez was assigned for full-time duties at ISA. During this same period, Arturo Riollano and Bernardino Rodriguez served as part-time consultants.

Complete details of all these activities are available through the Office of International Programs of the College of Agricultural Sciences.

In addition to the activities channeled through the Office of International Programs, the faculty itself serves as a resource sharing avenue. During the 1972-1973 academic year the Mayaguez Campus had a total of 590 undergraduate and 71 graduate foreign students, with the following distribution: Argentina - 5; Aruba - 1; Bolivia - 2; Colombia - 52; Costa Rica - 3; Cuba - 175; Curacao - 1; Ecuador - 6; Spain - 18; Guatemala - 5; Guyana - 2; Haiti - 32; Honduras - 3; British Honduras - 1; India - 3; England - 1; British Virgin Islands - 1; Italy - 1, Jordan - 2; Mexico - 3; Nicaragua - 9; Panama - 14; Paraguay - 1; Peru - 11; Dominican Republic - 186; Salvador - 3, Turkey - 1; Uruguay - 1; Venezuela - 16.

During the month of January, a group of students from the International Agriculture Program of Cornell University visited the island. During January 11 through January 17, they visited the Mayaguez area and were taken care of by staff members. In particular Professor Beinroth accompanied the group on their field trips.

#### VI. Other Resources for Grant-Related Activities

The grant contributes to the overall teaching efforts and teaching commitments of the Department of Agronomy of the University of Puerto Rico. As the chief goal of the grant is to strengthen the existing competency the funds provided by this grant cannot replace existing funds for current projects. On the contrary, activities carried out under this grant have been additives to existing programs at the University.

In direct support to the grant, the University has been providing and will continue to provide:

1. Administrative costs including salaries and utilities in all administrative offices and facilities. The basic salary of the project leader, Professor Rafael Pietri, \$ 14,400.00 comes from the University budget. No funds from the grant are used to cover costs of services of senior administrative officers in the College of Agricultural Sciences.
2. Access to all persons concerned or related to the grant to relevant laboratories, field research facilities, and libraries. The facilities of the Agricultural Experiment Station and its substations are also available. The field research under the grant is using a 6-acre plot at the Isabela substation. This land will be provided free of charges to the grant program. The services of the Central Analytical Laboratory of the Agricultural Experiment Station are also available free of charge. Money wise, these contributions are very difficult to assess and they are not shown in Table 1.
3. Office, classroom, and other space for faculty, students and special meetings related to the new program. In addition the University provides to all persons concerned or related to the grant all services and facilities that are normally provided to the regular staff and to the regular students. These contributions are also very difficult to assess and are not shown on Table 1.

4. The members of the faculty in the Agronomy Department not directly funded by the grant are considered an integral part of the grant program. Their salaries are shown in Table 1 as university support to grant supported activities.
5. The sub-professional personnel of the Department who are under university state funding are considered also an integral part of the grant program and take part in related activities. Their salaries are also shown in Table 1.

#### VII. Next Year's Plan of Work

Teaching: The University of Puerto Rico will continue cooperation on joint projects during 1973-1974. Two faculty members will be participating in the Tropical Soils Mineralogy workshop to be held in Hawaii from July 8-22, 1973. One of our staff members will be presenting a paper at the Seminar to be held at CIAT in Colombia as a joint consortium effort. Our staff members will be available for participation at the Tropical Soils Institute to be held during the summer of 1974 at the Philippines as a joint consortium effort.

In addition the following effort will be continued:

- (1) New courses on the subject of tropical soils will be added, and existing courses will be modified.
- (2) Training and teaching materials will be acquired to complement course offerings.
- (3) Physical layouts and facilities will be added or modified.
- (4) More graduate students will be recruited.
- (5) New laboratory facilities and equipment will be developed to support teaching and research activities of the program.

It is intended that all staff members will make visits to collaborating institutions in the mainland, to research stations, agricultural regions and institutions overseas and will attend scientific matters of mutual interest thus increasing their capability to work with tropical soils.

It is estimated that the anticipated expenditures related to the above mentioned activities will be as follows:

Salaries:

Professional-----	\$31,443.33
Graduate Assistants-----	9,000.00
Clerical-----	8,360.00

Stipends:

Fringe Benefits-----	\$ 8,000.00
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Travel:

Domestic-----	\$ 4,000.00
International-----	5,000.00

Departmental Support:

Equipment-----	\$10,000.00
Library and teaching aids-----	6,000.00
Supplies, Materials & Services-----	4,000.00

Research

In the area of nutrient level requirements, the same field trials that are being conducted in the Oxisol Coto clay will be planted in the Ultisols Humatas clay. The residual effect of the fertilizer application on the Coto clay trials will be evaluated, as well as on the Humatas clay.

The close collaboration that has been initiated with the University of Hawaii will be continued through the research projects.

It is estimated that the expenditures related to the above mentioned activities will be as follows:

Stipends:

Wages (Field laborers)-----\$10,942.00

Supplies, Materials & Services-----\$ 3,000.00

To further involve local advanced undergraduate students in the program, the establishment of undergraduate assistantships is being continued. These students will work closely with the senior staff members in routine work such as collecting samples for both soil and plant analysis and helping in routine laboratory work. They will be allowed to work not more than 15 hours per week and will be paid accordingly.

It is estimated we will have the following expenditures:

Stipends:

Wages Undergraduate Assistants-----\$ 8,932.00

VIII. Report of Expenditures

Review Period, July 1, 1972 to June 30, 1973

A. Summary

1. Salaries

1.1 Professional and Technical-----\$38,279.96  
 1.2 Graduate Assistants----- 11,175.00  
 1.3 Clerical----- 7,260.00

2. Stipends

2.1 Wages (field labor, irregular)-----\$11,643.54  
 2.2 Undergraduate Assistants----- 7,424.46  
 2.3 Employer contribution to fringe benefits--- 6,805.78

3.	Travel		
3.1	Domestic		
3.11	In Puerto Rico-----	\$	639.80
3.12	Outside Puerto Rico-----		2,843.61
3.2	International-----		4,610.30
4.	Supplies, Materials and Services-----		13,459.27
5.	Department Support		
5.1	Equipment-----		16,704.85
5.2	Library and teaching aids acquisitions-----		4,592.99
	Grand Total-----	\$	126,392.96

## B. Details

## 1. Item 1 of summary: Salaries

Friedrich H. Beinroth	Associate Professor	100%	\$14,500.00
Rafael Pietri Oms	Professor and Project Leader		
		100%	2,400.00
Milagros Miro	Associate Researcher & Assistant		
	Professor	100%	11,079.00
Ricardo Barahona	Research Assistant	100%	8,500.00
Victor Snyder	Graduate Assistant	100%	2,750.00
Jose E. Ramirez	Graduate Assistant	100%	2,625.00
Luz M. Velez	Typist	100%	3,960.00
Olga Carrero	Typist	100%	3,300.00

## 2. Item 2 of summary: Stipends

Secretarial irregular	100%	3,000.00
Field labor Laborers	irregular	8,643.54
Undergraduate students		7,424.46
Fringe Benefits (all employees)		6,805.78

## 3. Item 3.12 of summary: Travel Outside of Puerto Rico

## 3.1 Domesitc

3.121 R. Pietri, R. Abrams, F. H. Beinroth

To: Miami

Cost: \$ 1,015.35

Purpose: To attend the Soil Science Society of America Meeting.

3.122 Rafael Pietri Cost: \$ 358.36

To: Texas

Purpose: To attend the Executive Committee Meeting at Prairie View A&M College.

3.123 Rafael Pietri Cost: \$ 273.00

To: Washington

Purpose: To attend the annual review of the 211(d) grant, and to attend the meeting of the Council of Deans and the Executive Committee.

3.124 Friedrich H. Beinroth Cost: \$ 785.40

To: Hawaii

Purpose: To work on the preparation of manuscript of publications resulting from joint research.

3.125 Rafael Pietri Cost: \$ 411.50

To: Texas

Purpose: To attend the Soil Workshop at Prairie View A&M.

4. Item 3.2 of summary: Travel, International

3.21 Friedrich H. Beinroth Cost: \$ 274.00

To: Dominican Republic

Purpose: Objective: To correlate some soils of the Dominican Republic with soils of Puerto Rico, and to prepare field trip of Cornell students.

3.22 Rafael Pietri  
Raul Abrams Cost: \$ 1,453.30

To: Trinidad

Purpose: To attend seminar at University of the West Indies.

3.23 Rafael Pietri  
Friedrich H. Beinroth Cost: \$ 1,090.65

To: Venezuela

Purpose: To attend meeting of the Latin American Congress of Soil Science and visit the Llanos Orientales of Venezuela.

3.24 Rafael Pietri  
Raul Abrams Cost: \$ 1,010.35

To: Colombia

Purpose: To visit CIAT to organize an international symposium sponsored by consortium.

3.25 Rafael Pietri  
Fred H. Beinroth Cost: \$ 782.00  
Victor Snyder

To: Dominican Republic

Purpose: To attend and present papers at the Seminar on Tropical Savanna Soils.

5. Item 4 of summary: Supplies, Materials and Services

Here are included items distinct from general departmental supplies, materials, and services common to regular departmental projects. Here are included supplies, materials and services in support of specific activities of projects generated by the grant. Expenses will be itemized at your request.

6. Item 5.1 of summary: Equipment

5.11 Digital Read-out Accessory \$ 2,000.00

The accessory was added to the existing atomic absorption apparatus to increase the efficiency of the machine.

5.12 Air Conditioning Units \$ 1,538.52

Units were installed in different rooms to protect valuable electronic and optical equipment and to supplement the dehumidifiers.

5.13 Olivetti Microcomputer \$ 5,725.00

This piece of equipment is used for calculations of parameters involved in curve fitting for fertilizer response and statistical analysis. Used in all advance courses.

5.14 Water Still \$ 495.00

5.15 pH Meter \$ 415.00

5.16	Equipoise Shaker	\$ 605.00
5.17	Dry Bath Block	\$ 197.75
5.18	GBC Electric Perforator	\$ 1,295.00
5.19	GBC Electric Ring Binder	\$ 695.00
5.20	D. T. A. equipment, portable	\$ 802.50
5.21	Flat file	\$ 209.00

This equipment was needed to cope with the needs of the new program. These items are above the normal expenditures of the department and were needed to provide facilities for the work developed as a result of the new phases of the project.

7. Item 6 of summary: Library & Teaching Aids Equipment

6.1	Duplicating Machine	\$ 340.00
6.2	35 mm. Camera with accessories	\$ 982.50

The above equipment is essential for preparation of training materials and aids for teaching and resource development. These items help to increase the capabilities as called for in the grant proposal.

Table 1. Distribution of 211(d) Grant Funds and Contributions from other sources of Funding Review Period July 1, 1972 to June 30, 1973.

	211(d) Funding				Non 211(d) Funding Amount July 1, 1972 to June 30, 1973
	Period Under Review	Cumulative Total	Projected Next Year	Project End of Grant	
<b>Salaries:</b>					
Professional & Technical	\$38,279.96	\$68,523.29	\$31,443.33	\$155,734.47	\$70,843.30
Graduate Assis- tants	11,175.00	13,700.00	9,000.00	42,625.00	-----
Clerical	7,260.00	8,826.13	8,360.00	27,926.13	4,554.00
<b>Stipends:</b>					
Wages	11,643.54	21,029.54	10,942.00	64,328.00	10,626.00
Undergraduate Assistants	7,424.46	7,424.46	18,932.00	54,000.00	(1)
Fringe Benefits	7,759.18	9,036.12	8,000.00	8,000.00	-----
<b>Travel:</b>					
Domestic	3,483.41	7,150.71	4,000.00	24,667.30	4,622.94
International	4,610.30	12,850.36	5,000.00	20,240.06	-----
Supplies, Materials and Services	13,459.27	20,233.11	7,000.00	22,773.84	8,800.78
Departmental Support:					
Equipment	16,704.85	24,279.84	10,000.00	57,574.99	5,585.53
Library and teach- ing aids acqui- sitions	4,592.99	10,723.20	6,000.00	30,130.21	(2)
<b>Total</b>	<b>\$126,392.96</b>	<b>203,876.76</b>	<b>108,677.33</b>	<b>500,000.00</b>	

(1) Fringe benefits are paid by the central administration from a central fund based on total payroll.

(2) Library appropriations are made at a campus level.

Table 2. Expenditure Report (actual and projected) under institutional Grant AID/csd 2857  
Review period July 1, 1972 to June 30, 1973.

Line Items	Expenditures to Date Period Under		Projected Expenditures Year			Total
	Review	Cumulative	3	4	5	
Salaries	\$ 56,714.96	\$ 91,149.42	\$ 47,136.18	\$ 46,000.00	\$ 42,000.00	\$226,285.60
Stipends	26,827.18	37,500.12	28,000.00	28,000.00	24,828.88	118,328.00
Travel	8,093.71	20,001.07	8,500.00	8,500.00	7,906.29	44,907.36
Supplies, Materials	13,459.27	20,233.11	3,000.00	3,000.00	3,540.73	29,773.84
Departmental Support	21,297.84	35,003.04	16,000.00	16,000.00	13,702.16	80,705.20
<b>Total</b>	<b>\$126,392.96</b>	<b>\$203,876.76</b>	<b>\$102,636.18</b>	<b>\$101,500.00</b>	<b>\$ 91,978.06</b>	<b>\$500,000.00</b>