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REPORT OF UNIVERSITY OF PUERTO RICO
FOR THE PERIOD
JULY 1, 1971 TO JUNE 30, 1972

A. TITLE: A Grant to Strengthen the Capabilities of the University of Puerto Rico in Special Problems of Tropical Soils (Grant AID/CSD 2857)

B. GRANTEE: University of Puerto Rico

C. DIRECTOR: Dr. 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 period: \$77,483.80

3.2 Accumulated: \$77,483.80

3.3 Anticipated for next year: \$124,677.33

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 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
- (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 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

F. DETAILED REPORT

1. 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>
Cornell University	Tropical Soils Cultural Systems
North Carolina State University	Soil Fertility Relating Plant Nutrition to the Physical and Chemical Properties of Tropical Soils
Prairie View A&M College	Soil Fertility Problems Under Savanna-Prairie Ecology

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 specialties 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 mass 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 American-oriented in culture and language.

2. Objectives of the Grant

2.1 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

2.2 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 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 and conserved 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 of tropical soils and are, in addition, compelling ends in themselves consistent with the service to AID which is inherent 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.

3. Accomplishments

3.1 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. 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 from the Dean of Agriculture's office and matched with funds from the Dean of Studies' office 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 designed to familiarize the student with the latest instruments and their use in soil and plant analysis and will be offered for the first time in the spring semester of the 1972-73 academic year.

As of July 1, 1971 Dr. Fred H. Beinroth has been incorporated into 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.

Dr. Fred H. Beinroth participated in the 211(d) Soils Teaching Workshop held in Hawaii during the month of July 1971. 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 7-13, 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.

Dr. Miguel A. Lugo described two new courses on Soils Management. One is a course on "Topics in Tropical Soils Management" 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. The courses have been already incorporated to the department curriculum and will be offered in the 1973-74 academic year.

A significant new feature in the advanced undergraduate instruction has been the new approach given to the course, "Special Problems in Soils." With the appointment of Miss Miro, this course has been geared

toward exposing advanced undergraduate students to simple research problems. Four students during the fall semester and five during the spring term were involved in this type of academic activity. The topics were the following:

- (1) The micronutrient status in three Ultisols from Puerto Rico (Humatas clay, Alonso clay and Los Guineos clay)
- (2) The aluminum and manganese status of an Oxisol (Nipe clay) and an Ultisol (Humatas clay) under different ammendments
- (3) Chemical analysis of the profile of the Pastillo series
- (4) Chemical analysis of the profile of the Potala series
- (5) Chemical analysis of the profile of the Santa Cruz series
- (6) A comparison of different methods for organic matter analysis
- (7) The aluminum status of Alonso clay
- (8) The chemical composition of the tobacco plant growing under different nutrient levels on an Ultisol

Final plans have been made for a four-week Tropical Soils Institute to be held at the Mayaguez Campus in the summer of 1972. The details of this program are given in the section of this report describing the Plan of Work for 1972-73.

Preliminary arrangements have been made for several distinguished soil scientists to be on the Mayaguez Campus during the coming year. Their identity and their plan of work will be presented on the section of this report intituled Plan of Work for 1972-73.

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 expect to have for the 1972-73 academic year local graduate students in soil science for the first time. In addition, we expect to increase the number of graduate students from one to five.

3.2 Research: There are currently two graduate students either totally or partially funded under the 211(d) grant. Their research programs are part of the departmental contribution to the knowledge of tropical soils.

(1) Mr. Ricardo Barahona is a native of El Salvador, Central America. The objective of his research is to measure the physical, chemical and mineralogical properties of an Alonso clay profile. The information thus obtained will be useful in placing this soil within the categories established on the USDA Soil Taxonomy System. Mr. Barahona holds a graduate assistantship fully funded under 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.

Although the University of Puerto Rico does not have a research contract, staff members are actively engaged in research funded by 211(d). In an effort to procure the data required to initiate a

research project on the correlation of FAO/UNESCO soil units with taxa of the USDA Soil Taxonomy, a visit was paid by Fred H. Beinroth to the FAO headquarters in Rome, Italy. With 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 to 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. 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.

(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.

Dr. Fred H. Beinroth spent six weeks in Hawaii initiating a geomorphic pedogenetic study, starting in this way a cooperative project whereby soils of Puerto Rico and of Hawaii will be correlated in terms of chemical, physical and mineralogical characteristics. At the same time, these same soils will be also correlated with the FAO system and correlation tables have been prepared. During this work he was financially supported by both Puerto Rican and Hawaiian 211(d) funds. A publication will come out sometime next year.

A number of research projects on the nutritional level requirements of tropical food crops were initiated during this year. Two groups of plants were used--(1) edible legumes which included pigeon peas, field beans and cow peas and (2) root crops which includes yams (Dioscorea sp.), taniars (Xanthosoma sp.) and cassava (Manihot sp.). The objective is twofold--(1) to determine the response of varieties or cultivars of these crops to maximum fertilizer applications and/or (2) to determine the lack of response of any of the varieties or cultivars, thus providing a crop which could be grown under primitive farming systems without the need of complex technological inputs. This work will be done in the two principal tropical soil orders, Oxisols and Ultisols.

Pigeon peas, field beans and cowpeas trials have already been harvested and the data are being analyzed. Full reports are expected to be published during the coming year. The yams, taniars and cassava trials are on the field and are to be harvested during the months of October and November 1972. Complete data and full reports will be available for next year's annual report.

A field trial of the nutritional requirements of field beans and corn was started on a plot simulating severe sheet erosion. The topsoil 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 last June. A full report will be available for next year.

4. 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 prompted 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 1971-72 academic year saw our second student coming in. For the 1972-73 academic year we expect to have our first local graduate student and for 1973-74 we expect to have five in all.

The interest caught up with other sectors and the result has been a number of new grant proposals submitted to different agencies. Among

them--a proposal for the improvement of bean, soybean and cowpea production in the tropics through disease and insect control; a proposal for the improvement of sorghum production techniques in the tropics and a proposal for an international soybean research and development center.

5. 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.

5.1 AID/ROCAP-83 contract: This contract calls for the graduate training in Puerto Rico of personnel from Central American universities. Eleven participants were in Puerto Rico during the 1971-72 academic year from four different areas--Costa Rica, Nicaragua, Guatemala and El Salvador.

Another phase of the contract calls for our sending visiting professors to these same areas. During the 1971-72 academic year the following staff members were on this assignment:

José R. Mondonado	Universidad de San Carlos, Guatemala
Alberto Febre	Universidad de San Carlos, Guatemala
Eddie Alvarez	Universidad de El Salvador, San Salvador
Luis Alvarez	Universidad de Nicaragua
Justo Hernandez	Universidad de Nicaragua
Silverio Medina	Universidad de Costa Rica

5.2 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 1971-72 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.

During the month of August 1971 nine staff members of ISA visited the Mayaguez Campus for discussions with their colleagues.

5.3 Short courses by agreement with AID/OIT: Short courses were offered during 1971-72 under this agreement. Participants from Brazil, Honduras, Panamá, Colombia, Venezuela and Costa Rica spent from six weeks to six months in Puerto Rico in different short courses that took place during this period. Fifty-five students attended the offerings.

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 1971-72 academic year the Mayaguez Campus had a total of 600 undergraduate and 74 graduate foreign students, with the following distribution: Argentina, 5; Aruba, 1; Bolivia, 2; Brazil, 1; Canada, 2; Chile, 4; China, 1; Colombia, 51; Costa Rica, 4; Cuba, 217; Curacao, 1; Ecuador, 8; Spain, 13; Guatemala, 7; Guyana, 1; Haiti, 33; Honduras, 4; British Honduras, 3; India, 2; England, 2; British Virgin Islands, 2; Italy, 2; Jordan, 1; Martinique, 1; Mexico, 2; Nicaragua, 11; Panamá, 19; Pakistan, 1; Peru, 12; Dominican Republic, 231; Salvador, 5; St. Kitts, 1; Surinam, 1; Trinidad, 1; Uruguay, 1; Venezuela, 18.

During the month of January a group of students from the International Agriculture Program of Cornell University visited the island. During January 11-14 they visited the Mayaguez area and were taken care of by staff members. In particular, Prof. Beinroth accompanied the group on their field trips.

6. 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 make the following inputs.

6.1 Administrative costs including salaries and utilities in all administrative offices and facilities. The basic salary of the project leader, Prof. Rafael Pietri, \$13,620 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.

6.2 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 three-acre plot at the Isabela substation and an additional three-acre plot will be needed for next year. 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 on Table 9.1.

6.3 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 9.1.

6.4 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 9.1 as university support to grant-supported activities.

6.5 The sub-professional personnel of the department who are university-state appropriate funding are considered also an integral part of the grant program and take part in related activities. Their salaries are also shown in Table 9.1.

6.6 The regular budget appropriations for supplies and materials for the Soil Science section of the Agronomy Department provided through state funds have been placed under the direct control of the grant project leader. This follows the same line of thinking already stated in the above paragraphs. All available resources are pooled in order to make a more efficient use of all of them. These appropriations appear in Table 9.1.

6.7 As an additional item, we have to mention the assignment part time of Dr. Jose Badillo from the Agricultural Experiment Station to the research program of the grant. Dr. Badillo will devote 50 percent of his time to supervise the field trials on root crops at the Isabela substation and at the College Farm. He is and will continue to be state-funded.

7. Next Year's Plan of Work

7.1 Teaching: Three new courses will be included in the offerings for next year. These will be Instrumental Analysis of Soils and Plants, Topics in Tropical Soils Management, and Management of Tropical Soils. In addition, the revised courses of Genesis, Morphology and Classification of Soils and Soils of Puerto Rico will be moved to the group of advanced undergraduate and graduate courses.

Final plans for a Tropical Soils Institute have been drawn. The Institute will provide intensive instruction in the application of current knowledge of soil science and related disciplines to problems of crop production in the tropics. It will be 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. It will take place from July 10 to August 4 at the Mayaguez Campus of the University of Puerto Rico.

A faculty recruited from the five institutions will participate; so far the following have accepted and will be guest lectures:

Dr. Goro Uehara
Dept. of Agronomy & Soil Science
University of Hawaii
2525 Varney Circle
Honolulu, Hawaii 96822

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

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

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

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

Dr. José 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 will be covered; namely:

- (1) Soil Genesis, Geomorphology, Classification and Climatology, under the responsibility of Dr. Fred H. Beinroth, University of Puerto
- (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 will meet 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 will give the opportunity to the participants to visit all the ecological areas in the island.

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

Library facilities on the literature on tropical soils will be inventoried and an index of available material will be prepared.

Plans are been made to use 211(d) funds to purchase a DTA-TGA machine to complete the instrumentation of the soils mineralogy laboratory.

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 meetings in order to be able to discuss with other scientists 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	9,600.00
Travel	
Domestic	6,000.00
International	5,000.00
Departmental Support	
Library and teaching aids	6,000.00
Equipment	10,000.00
Supplies, Materials and Services	4,000.00

7.2 Research: Two new projects centering on the area of Soil Genesis, Morphology and Classification are contemplated:

- (1) Correlation of the soils of Puerto Rico with soils of South America
- (2) Evaluation of mineralogic criteria applied for Oxisols and Ultisols in the USDA soil taxonomy

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 Ultisol Humatas clay. The residual effect of the fertilizer application on the Coto clay trials will be evaluated.

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)	\$6,942.00
Fringe Benefits	932.00
Supplies, Materials & Services	3,000.00

7.3 Visiting scientists and staff additions: Commitments have been made with Dr. Hans W. Fassbender and Dr. Van Wambeke to visit the Mayaguez Campus as Visiting Lecturers. Dr. Fassbender is scheduled to arrive on September 4, 1972 and stay until September 30, 1972. During his stay he will deliver twelve lectures in Soil Chemistry in Mayaguez and two at Rio Piedras and will be available to the graduate students and to staff members for consultation. Dr. Van Wambeke will visit us during the spring term under the same terms as Dr. Fassbender.

Dr. Hector Lugo Mercado who has completed the Ph. D. at North Carolina State University will be incorporated to the staff on a full-time capacity.

Plans are being drawn to recruit a junior staff member in the area of soil fertility and plant nutrition.

To further involve local advanced undergraduate students in the program, the establishment of undergraduate assistantships is being contemplated. 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:

Salaries

Visiting Lecturers	\$ 6,000.00
Junior Staff Member	12,000.00
Fringe Benefits	1,800.00

Stipends

Wages, Undergraduate Assistants	4,000.00
Fringe Benefits	600.00

8. Other: No additional report.

9. Report of Expenditures

9.1 Distribution of 211(d) grant fund expenditures and contributions from other sources of funding (see Table 9.1).

9.2 Expenditure report, actual and projected (see Table 9.2).

9.3 Budget: Summary

Salaries

Professional and Technical	\$30,243.33
Graduate Assistants	2,625.00
Clerical	1,566.13
Sub-professional Assistants (field labor, irregular)	9,386.00
Fringe Benefits	1,276.94
Travel	
Domestic	3,667.30
International	8,240.06

Supplies, Materials and Services	\$ 6,773.84
Equipment	7,574.99
Library & Teaching Aids Acquisitions	6,130.21
	<hr/>
Total, All Objects	\$77,483.80

9.4 Budget: Detail

9.4.1 Salaries and wages

<u>Name and Position</u>	<u>Percent of Time on Project</u>
Friedrich H. Beinroth, Associate Professor	100
Rafael Pietri Oms, Professor & Project Leader	100
Milagros Miro, Associate Researcher & Assistant Professor	100
Ricardo Barahona, Graduate Assistant	100
Secretary	100

9.4.2 Travel

(1) Domestic

Name: Milagros Miro Cost: \$499.00
 To: New York and Boston
 Purpose: To attend the Soil Science Society of America Meeting in New York and the Norelco Instrumentation Course in Boston

Name: Raul Abrams Cost: \$815.22
 Rafael Pietri \$815.22
 To: Hawaii
 Purpose: To attend the Executive Committee meeting at the University of Hawaii

Name: Miguel Lugo Cost: \$315.00
 Rafael Pietri \$315.00
 To: Washington
 Purpose: To attend the annual review of the 211(d) grant and to attend a joint meeting of the Council of Deans and the Executive Committee

Name: Friedrich H. Beinroth Cost: \$230.70
 To: Ithaca, New York
 Purpose: Lecture at Cornell on Tropical Soil Genesis and discuss final plans for Section I of the Tropical Soils Institute

9.4.2 Travel (Cont.)

(2) International

Name: Friedrich H. Beinroth Cost: \$772.60
 To: Germany and Italy
 Purpose: Attend meeting of Commission V and VI of
 International Soil Science Society and visit FAO
 headquarters in Rome to discuss research projects

Name: Rafael Pietri Cost: \$2,204.65
 Raul Abrams
 To: Nigeria, Kenya
 Purpose: To attend seminar at IITA and to visit agri-
 cultural regions and experiment station in
 western and eastern Africa

Name: Friedrich H. Beinroth Cost: \$1,993.16
 To: Nigeria, Kenya, Uganda
 Purpose: To attend seminar at IITA, visit agricultural
 regions and experiment stations in west and
 east Africa

Name: Milagros Miro Cost: \$1,065.00
 To: Madrid
 Purpose: To attend the International Clay Conference

9.4.3 Supplies, materials and services: In this item 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 request.

9.4.4 Equipment: A pre-mix flow burner kit was added to the existing atomic absorption apparatus to extend and increase the operating range of the machine. An air conditioning unit was installed in the spectrometer laboratory to supplement the dehumidifiers and thus give a greater protection to the equipment.

Fisher Scientific Company pre-mix flow burner kit for Jarrell-Ash atomic absorption spectrometer	\$742.50
Air conditioning unit, Westinghouse 18,000 BTU	249.00

The following equipment was needed to cope with the needs of the new program. The items included are above the normal expenditures which the department incurs in their services to all projects. The equipment was needed to provide minimal facilities for the office and paper work in all phases of the project.

Typewriter, IBM Model D-19	\$ 585.00
Credenza Model 712, Cole	169.00
Desk, Cole, Model 1784N	214.00
Desk with pedestal, Cole	159.00
Gestetner duplicating machine	1,150.00
Gestetner paper folder	380.00
Gestetner paper collator, Model 8S	375.00
Gestetner paper cutter	185.00
Gestetner photocopying machine, Model C-10	1,450.00
Air conditioning unit, Fedders, 18,000 BTU	249.00

9.4.5 Library and teaching aids (equipment): The following equipment was essential for preparation of training materials for teaching and resource development. These items help to provide the capabilities for developing teaching, training materials and informational services as called for in the grant proposal.

Kodak Carrousel 35 mm projector, Model 860W 3 mm lens	\$ 207.21
Polaroid photographic laboratory with M-P3 hand camera	1,631.04
Gestetner scanner, Gestefax, Model 456	2,505.00
Nystrom relief maps	488.30
Stacor map flat file	260.00
3M portable vertical projector	269.00
Kodak Vugraphic Beseler vertical projector	195.74
Copier cart (two)	300.00
Unitech lettering set	125.00

Table 9.1. Distribution of 211(d) grant fund expenditures and contributions from other sources of funding (review period July 1, 1971 to June 30, 1972)

Object	211(d) Source				Non 211(d) Source
	Period Under Review	Cumulative Total	Projected Next Year	Projected to End of Grant	
Salaries					
Professional & Technical	\$30,243.33	\$30,243.33	\$ 49,443.33	\$155,734.47	\$64,403.00
Graduate Assistants	2,625.00	2,625.00	9,000.00	42,625.00	
Clerical	1,566.13	1,566.13	8,360.00	27,926.13	4,140.00
Stipends					
Wages	9,386.00	9,386.00	10,942.00	64,328.00	9,660.00
Fringe Benefits	1,276.94	1,276.94	12,932.00	54,000.00	a
Travel					
Domestic	3,667.30	3,667.30	6,000.00	24,667.30	4,202.68
International	8,240.06	8,240.06	5,000.00	20,240.06	
Supplies, Materials & Services	6,773.84	6,773.84	7,000.00	22,773.84	8,000.78
Departmental Support (Equipment)	7,574.99	7,574.99	10,000.00	57,574.99	5,077.76
Library & Teaching Aids (Acquisitions)	6,130.21	6,130.21	6,000.00	30,130.21	196.50 ^b
Total	\$77,483.80	\$77,483.80	\$124,677.33	\$500,000.00	\$95,680.72

^aFringe benefits are paid by the central administration from a central fund based on total payroll

^bLibrary appropriations are made at a campus level

Table 9.2. Expenditure report, actual and projected (review period July 1, 1971 to June 30, 1972)

Object	Actual Expenditures		Projected Expenditures				Total
	Period Under Review	Cumulative Total	Year				
			2	3	4	5	
Salaries	\$34,434.46	\$34,434.46	\$ 66,803.33	\$ 47,047.81	\$ 46,000.00	\$32,000.00	\$226,285.60
Stipends	10,662.94	10,662.94	23,874.00	30,000.00	30,000.00	23,791.06	118,328.00
Travel	11,907.36	11,907.36	11,000.00	8,000.00	7,000.00	7,000.00	44,907.36
Supplies, Materials	6,773.84	6,773.84	7,000.00	3,000.00	3,000.00	3,000.00	22,773.84
Departmental Support	13,705.20	13,705.20	16,000.00	26,000.00	16,000.00	16,000.00	87,705.20
Total	\$77,483.80	\$77,483.80	\$124,677.33	\$114,047.81	\$102,000.00	\$81,791.06	\$500,000.00