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(101) Hawaii. Univ. Dept. of Agronomy and Soil Science

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

A. TITLE: A Grant to Strengthen the Capabilities of the University of Hawaii in Special Problems of Tropical Soils (Grant AID/CSD 2833)

B. GRANTEE: University of Hawaii

C. DIRECTOR: Dr. Wallace G. Sanford

D. STATISTICAL SUMMARY

1. Period of Grant: November 2, 1970 to November 2, 1975

2. Amount of Grant: \$500,000

3. Expenditures

3.1 For report period: \$83,187

3.2 Accumulated: \$107,390

3.3 Anticipated for next year: \$166,744

E. NARRATIVE SUMMARY

A cooperative project with the University of Puerto Rico in classifying the soils of Hawaii and Puerto Rico according to the FAO system and in correlating the chemical and physical characteristics of these soils at the family level were the major accomplishments during the past year. Drs. H. Ikawa and G. Uehara, in collaboration with Dr. F. Beinroth of Puerto Rico, have completed the classification of Hawaiian soils. Of the 190 soil series in Hawaii, the greatest number are Andosols, Phaeozems, Acrisols, Cambisols, Ferralsols, Histosols, Vertisols; Gleysols are also common. Dr. Ikawa has also developed a computer program for retrieval of these 190 soil series at different categories. This information will enable researchers in the tropics, working with similarly classified soils, to take advantage of the

research done in Hawaii and other tropical areas concerning land use, cropping, fertilization, and irrigation. Drs. Beinroth, Uehara and Ikawa completed a preliminary geomorphic-pedogenetic study of relationships of Oxisols and Ultisols in Hawaii. Generally, Ultisols occur on steeper slopes than Oxisols and the formation of oxic horizons is accelerated by readily weatherable ultrabasic rocks. It is hoped that similar studies in Hawaii and Puerto Rico will increase understanding of the formation of these soils.

Dr. Leslie D. Swindale, Associate Director and Professor of Soil Science, Hawaii Agricultural Experiment Station, and Dr. Goro Uehara, Professor of Soil Science, College of Tropical Agriculture, attended a seminar on Tropical Soil Research which was held in Ibadan, Nigeria, May 22-26, 1972. The sponsors of this seminar were the Ford Foundation, L'Institut de Recherches Agronomiques Tropicales, and the International Institute of Tropical Agriculture (IITA).

The seminar participants included a group of U. S. Soil scientists of the 211(d) University Consortium and from AID. The Institutions involved were Cornell, Hawaii, North Carolina State, Puerto Rico, and Prairie View A&M. Participants of the seminar visited several African nations. The experiences gained from this activity will improve instruction, research, and consultation capability in tropical soil management of member institutions.

One of the goals of this AID grant was the initiation of a faculty and student exchange program with other institutions in the Consortium. Hence under the provisions of the 211(d) grant, Dr. Martin Alexander of Cornell University was able to come to Hawaii to present lectures on

soil microbiology as well as to consult with interested members of this department. In addition, this grant enabled Mr. Cesar Lopez of Prairie View A&M College to work under Drs. Green and Koch in studying the degradation of herbicides in tropical soils.

Implementation of audio-visual tutorial techniques in the instruction of the department's basic soils course, Introduction to Tropical Soils, was successfully accomplished by Dr. H. Ikawa.

Drs. Uehara and Fox will be participants in the AID-sponsored Tropical Soils Institute to be held at the University of Puerto Rico, July 10 to August 5, 1972. Other faculty participants are members of the Consortium. An intensive four-credit course, divided into the following sections: (1) soil classification, geomorphology, and climatology; (2) soil physics and mineralogy; (3) soil chemistry, fertility and water relations; and (4) soil management systems, is being offered. Student participants will be primarily composed of those from Latin American countries.

During the last reporting period, Dr. Uehara was invited by the Thailand AID Mission to discuss possible research contracts on silting and soil-water-plant research in the Mekong Delta. Since that time, Dr. Uehara has been awarded a one-year contract to study the composition of Mekong River silt and its possible role as a source of plant nutrient in the Delta. Negotiations regarding participation in another Mekong Delta contract will be in progress. Actual work on this project should commence in the latter part of the year. From August 11 to 20, 1972, Dr. Uehara will participate in an organizational meeting in Saigon, Vietnam to discuss possible AID-University of Hawaii contracts on agricultural potential of heavy clay delta soils.

Another grant possibility is a proposal submitted by Dr. L. D. Swindale to the AID on the relation of soil families to crop productivity in the tropics. This proposal is designed to classify the soil families of lesser developed countries and to acquaint agriculturalists in those countries with soil management and crop production practices developed for similarly classified soil families in Hawaii and the tropics.

Negotiations will be undertaken with the Bougainville Copper Company in regard to a contract involving revegetation of road cuts, overburden dumps, and tailings involved in the mining operation on the Island of Bougainville which is part of the Soloman chain of islands. The knowledge gained from this project should be extremely useful in other developing nations where similar mining operations are contemplated. Drs. Sanford and Fox are the proposed project leaders.

The Department will propose to the Executive Committee and Council of Deans that we sponsor a workshop on mineralogy similar to the one held in Hawaii in the summer of 1971. It is proposed that participants be those individuals within the Consortium who are involved in soil mineralogy, teaching and research and other related subjects.

F. DETAILED REPORT

1. General Background and Purpose of the Grant: In making this grant, the principal criterion used was the degree of commitment a university is making or willing to make in increasing its competence in tropical agriculture. Development of this competence would lead to a better understanding of significant agricultural problems relevant to emerging nations in the tropics. To this end, AID awarded five-year grants to establish centers of competence in tropical agriculture at

existing institutions with permanent sources of funding and commitments on problems of international development.

2. Objectives of the Grant

2.1 Objectives restated: 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

2.2 Review of objectives: The objectives listed above will remain essentially the same except more emphasis will be placed on

extension work particularly when such work is compatible with the work being done in teaching and research. For example, individuals traveling to other areas whether on 211(d) or other funds should make available their services as experts when requested by appropriate individuals.

3. Accomplishments

3.1 Teaching: One of the goals of this AID grant was the initiation of a faculty and student exchange program with other institutions in the Consortium. Hence under the provisions of the 211(d) grant, Dr. Martin Alexander of Cornell University was able to come to Hawaii to present lectures on soil microbiology as well as to consult with interested members of this department. In addition, this grant enabled Mr. Cesar Lopez of Prairie View A&M College to work under Drs. Green and Koch in studying the degradation of herbicides in tropical soils.

Implementation of audio visual tutorial techniques in the instruction of the department's basic soils course, Introduction to Tropical Soils, was successfully accomplished by Dr. H. Ikawa. With the assistance of Dr. Hank Foth, a visiting professor from Michigan State University, this basic soils course was restructured from the conventional lecture-laboratory to the lecture-audio visual tutorial teaching method. The revamped course was taught in the fall of 1971. Dr. R. E. Green also used the audio visual tutorial system in introductory course entitled "Soils and Man." This course was offered in the spring of 1972 to non-soils majors within and outside the College of Tropical Agriculture. "Soil Microbiology" and "Plant Tissue Culture," two relatively new courses in the department, were offered during the fall and

spring semesters, respectively. State funds and a limited amount of 211(d) funds were used to get these courses underway.

Courses in soil physics, chemistry, mineralogy, and fertility continued to emphasize the unique physical, chemical, and mineralogical properties of tropical soils in comparison to those of temperate regions. Climatic differences were discussed by Dr. P. C. Ekern in "Meteorology in Agriculture." Through the initiative of Dr. R. L. Fox, an innovative field experiment was conducted by classes in soil fertility, soil physics, agricultural engineering, and statistics to allow students in each discipline to apply their classroom knowledge to field conditions. Four plots of sweet corn, with differences in planting density, were grown under varying rates of nitrogen fertilization and irrigation. Indications are that this method of teaching is very effective in integrating knowledge of agricultural systems.

Single page handouts of "Illustrative Concepts of Tropical Agriculture" continued to be printed. Each sheet discussed a single concept which should be emphasized in the teaching of tropical soils and plant nutrition. Four have been printed and are available to the members of the Consortium or to other organizations upon request.

3.2 Research: The University of Hawaii has started a cooperative project with the University of Puerto Rico in classifying the soils of Hawaii and Puerto Rico according to the FAO system and correlating the chemical and physical characteristics of these soils at the family level. Drs. Ikawa and G. Uehara in collaboration with Dr. F. Beinroth of Puerto Rico have completed the classification of Hawaiian soils. Of the 190 soil series in Hawaii, the greatest number are Andosols. Phaeozems, Acrisols, Cambisols, Ferralsols, Histosols,

Vertisols, and Gleysols are also common. Dr. Ikawa has also developed a program for computer retrieval of these 190 soil series at different categories. This information will enable researchers in the tropics working with similarly classified soils to take advantage of the research done in Hawaii and other tropical areas concerning land use, cropping, fertilization, and irrigation. Drs. Beinroth, Uehara and Ikawa have also completed a preliminary geomorphic-pedogenetic study of relationships of Oxisols and Ultisols in Hawaii. Generally Ultisols occur on steeper slopes than Oxisols and the formation of oxic horizons is accelerated by readily weatherable ultrabasic rocks. It is hoped that similar studies in Hawaii and Puerto Rico will increase understanding of the formation of these soils.

Mineralogical characterization of 11 of Puerto Rico's most important agricultural soils was completed at the University of Hawaii. Using electron microscopy and X-ray diffraction, Dr. R. C. Jones, Dr. W. Sakai, and Mr. W. Hudnall studied samples brought to Hawaii by Dr. Beinroth of 65 horizons of 5 Ultisols and 6 Oxisols. In addition to mineralogy, particle size distribution was determined by Dr. G. Tsuji. Detailed descriptions of seven of these soils were included in the handbook compiled by Dr. Beinroth for the Tropical Soils Institute to be held in Puerto Rico, July 10-August 4, 1972. These studies are part of an effort to properly classify the Puerto Rican soils at the family level and to determine if similarly classified soils in Hawaii behave alike. If predictions concerning management can be made through proper classification, then recommendations can be made to agriculturalists using similarly classified tropical soils. Dr. R. Fox made measurements of soluble silica, phosphate, and sulphate sorption by these Puerto Rican

soils. Comparison of these measurements with those of Hawaiian soils will aid in prediction of soil behavior based on family designation.

Dr. A. H. Sayegh, Associate Professor of Soil Science at the American University of Beirut, spent his sabbatical leave here during the period September 1, 1971 to June 2, 1972 and was supported in part by 211(d) funds. During this period he attended advanced courses on the mineralogy and physical chemistry of tropical soils and engaged in preliminary studies with Dr. S. A. El-Swaify on the charge characteristics of oxidic and amorphous separates of a Typic Hydrandept and a Typic Gibbsihumox. The adsorption of H^+ and OH^- was directly related to the adsorption of Cl^- and NH_4^+ , respectively. The first pair acted as charging ions and the second as counter ions. Net charges associated with the Hydrandept were considerably more subject to variation due to changes in pH and concentration of electrolyte than those associated with the Gibbsihumox.

The X-ray fluorescence quantometer has been installed and is presently being calibrated using data obtained from other instruments. E. Okazaki and Dr. Jones expect to shortly begin processing samples of soil, tissue, and forage.

Dr. J. Silva recently returned from a sabbatical leave spent at Cornell University. While there, he presented guest lectures in Agronomy, Geography of Tropical Soils, Soil Fertility, and Tropical Crop Production, and collaborated in a research project in which extractable Si and P levels and responses to calcium silicate, lime, and phosphate of comparable soils from Puerto Rico, Colombia, and Hawaii were evaluated. Greatest response to calcium silicate was in the Gibbsihumox (Hali) soil from Hawaii, the Oxisol (Catalina) from Puerto

Rico, and Carimagua soil of the two tested from Colombia. All soils responded markedly to phosphorus and most responded to increased calcium and pH.

Drs. L. D. Swindale and G. Uehara attended the AID 211(d) Soils Consortium meeting held in Nigeria. There Dr. Uehara presented a paper relating his work with the behavior of soils with variable charge colloids. Colloids with variable surface charge are more commonly found in tropical soils than in soils of the temperate regions. Minerals which commonly behave as variable charge colloids were found to be crystalline and non-crystalline oxides and hydrous oxides of silicon, aluminum, iron, manganese and titanium, and the non-crystalline alumino-silicates. In soils with variable charge minerals, specific adsorption of anions caused the cation exchange capacity to increase, and specific adsorption of cations caused the cation exchange capacity to decrease. For these soils, research indicated that prediction of soil behavior could be improved if a model based on variable charge colloid was used.

An M. S. program which characterized an almost entirely non-crystalline Hawaiian soil (Hilo, Typic Hydrandepts) was recently completed. Electron microscopy of this important sugar cane-producing soil showed three phases: (1) a gel affected by chemical treatments of H_2O_2 and/or $CaCl_2$, (2) short spindle-shaped rods, and (3) long strings of imogolite not affected by dissolution treatments. Studies of the non-crystalline fraction of several Florida soils were also completed by Dr. T. Yuan of the University of Florida who was on sabbatical leave and Drs. Jones and Sakai. They found that the amorphous organic

and inorganic portion of these sandy soils played an important role in their chemical properties.

Soil chemistry research indicated that sugar cane roots played a predominant role in degrading ametryne herbicide in tropical soils. Work has also shown that water held in small intra-aggregate pores of highly structured Oxisols does participate in liquid flow. However, such micropores hold back adsorbed solutes more than equilibrium measurements predict. Research on nitrogen has shown that nitrate adsorption in dominantly amorphous Akaka soil and kaolinitic Molokai soil increased consistently with increasing electrolyte concentration. The magnitude of adsorption was greater in the Akaka soil and this soil also showed an increase in adsorption with increasing soil depth. Work with the kaolinitic Wahiawa and montmorillonitic Lualualei soils showed that ammonification and nitrification of slowly available nitrogen fertilizers took place at 7, 27, and 40°C but rates of these processes varied with temperature. "Osmocote" (plastic coated) released the highest amount of available nitrogen in the soils at all temperatures followed by sulfur-coated urea, IBDU, urea formaldehyde and sewage sludge. Sulfur-coated urea produced the highest amount of $\text{NH}_4\text{-N}$ and "Osmocote" the highest $\text{NO}_3\text{-N}$ in both soils at all temperatures.

Studies on water quality standards for irrigated tropical soils showed that in addition to total salt concentration and the proportion of sodium to other cation, the presence of certain anions in irrigation water has an effect on soil structure. Among four anions studied, the relative effect on soil structure could be arranged in the decreasing order: $\text{SiO}_3^- > \text{HCO}_3^- > \text{SO}_4^- > \text{Cl}^-$. This effect also increased as the

proportion of amorphous components in the soil decreased. Research using drip irrigation with sugar cane has shown that normal yields can be achieved with a 15 to 25 percent water savings.

Approximately 60 percent of the 211(d) funds were used to support soil mineralization and characterization research. The balance was used in travel and the general support of tropical soil research and teaching within the department.

3.3 Reports, working papers, and publications

- Beinroth, F. H., H. Ikawa, and G. Uehara. 1971. Preliminary report on the placement of the soils of Hawaii in the FAO/UNESCO legend for the soil map of the world. 6 p.
- Beinroth, F. H., H. Ikawa, and G. Uehara. 1971. Report on a preliminary study of landscape relationships of Oxisols and Ultisols in Hawaii. 5 p.
- Chan, J. K., R. C. Jones, and W. S. Sakai. 1972. Mineralogical characterization of the Hilo soil (Typic Hydrandepts). Agron. Abst.
- Fox, R. L. 1971. Growth response curves--The "Law of Diminishing Returns." Illus. Concepts in Trop. Agr.
- Fox, R. L. 1971. Symptoms of plant nutritional deficiency--Visual symptoms and incipient malnutrition. Illus. Concepts in Trop. Agr.
- Fox, R. L. 1972. Solubility, uptake and leaching of plant nutrients: Phosphate, sulfate, and calcium. Proceedings Fifth Hawaii Fert. Conf., Misc. Pub. 86, Hawaii Agr. Exp. Sta. p. 25-32.
- Fox, R. L. and Y. Tamimi. 1971. Symptoms of plant malnutrition--Multiple deficiencies and "The Law of the Minimum." Illus. Concepts in Trop. Agr.
- Fox, R. L. and R. M. Warner. 1971. Symptoms of malnutrition--Influence of nutrient mobility on iron deficiency. Illus. Concepts in Trop. Agr.
- Fox, R. L. and R. M. Warner. 1971. Excess phosphate and micro-nutrient deficiency in macadamia. Hawaii Farm Sci. 20(4): 2-4.
- Jones, R. C. 1972. New methods of elemental analysis for soils and plant tissues at the College of Tropical Agriculture. Proc. Fifth Hawaii Fert. Conf., Misc. Pub. 86, Hawaii Agr. Exp. Sta. p. 39-41.

- Kanehiro, Y. and D. T. Mikami. 1972. Some exchange adsorption and fixation properties of amorphous volcanic ash soils of Hawaii. Trans. of Panel on "Volcanic Ash Soils of America." Pasto, Colombia.
- Sakai, W. S., M. Hansen, and R. C. Jones. 1972. Raphides with barbs and grooves in Xanthosoma sagittifolium (Araceae). (in press) Sci.
- Uehara, G., L. D. Swindale, and R. C. Jones. 1972. Mineralogy and behavior of tropical soils. Seminar on Trop. Soil Res., Ibadan, Nigeria.
- Yuan, T. L., R. C. Jones, and W. S. Sakai. 1972. Colloidal fraction of selected Florida soils. Agron. Abst.

4. Impact of Grant-Supported Activities in Developing Institutional

Capabilities: The grant has had a large impact on teaching and research. Hawaii does research in all phases of tropical soils. However, previous to the AID grant much of the work was restricted to Hawaiian soils. Travel by University personnel and visits by researchers working in other tropical areas has greatly increased the scope of interest and teaching at the University. The competence of the University especially in the areas of soil biology and mineralogy has increased greatly under this grant. A soil mineralogist, Dr. R. Jones, with state funds and with AID support two post-doctoral associates, Drs. G. Tsuji and W. Sakai, Dr. C. A. Bower and Mr. E. Okazaki, were hired to work in the area of soil physics, biology, chemistry and mineralogy. The instrumental capabilities in the department has been greatly enhanced by the AID 211(d) grant. Although 211(d) monies were not involved in the acquisition of the X-ray fluorescence quantometer (\$100,000) and the scanning electron microscope (\$80,000) with a micro probe attachment (\$26,000), it provided the initial impetus to acquire both instruments, which were purchased through state and federal sources. Monies from 211(d) were used to buy needed photographic

darkroom equipment and supplies for the film processing and printing of electron micrographs. Accessories to the quantometer and scanning electron microscope (electron probe) were also purchased by this fund. Both instruments have added immeasurably to the analytical capability of this department in terms of biological, chemical and mineralogical research.

5. Utilization of Institutional Resources in Development:

Dr. Leslie D. Swindale, Associate Director, Hawaii Agricultural Experiment Station and Dr. Goro Uehara, Professor of Soil Science, College of Tropical Agriculture, attended a seminar on Tropical Soil Research which was held in Ibadan, Nigeria, May 22-26, 1972. The sponsors of this seminar were the Ford Foundation, L'Institut de Recherches Agronomiques Tropicales, and the International Institute of Tropical Agriculture (IITA). This was the 13th in a series of agricultural research and development seminars held by the three co-sponsors. The seminars in 1970 and 1971 were crop or research discipline oriented. The 1972 seminar series sought to examine those factors of African agriculture's infrastructure that may act as constraints on the development of new agricultural technology. The seminars also identified and brought together workers and agencies engaged in a study of those problems and to exchange information and ideas on the methods of solving infrastructure problems. The seminar participants included a group of U. S. soil scientists of the 211(d) University Consortium and from AID. The universities involved were Cornell, Hawaii, North Carolina State, Puerto Rico, and Prairie View A&M. Participants of the seminar visited several African nations. The experiences gained from this activity

will improve instruction, research, and consultation capability in tropical soil management of member institutions.

Dr. Donald L. Plucknett has been invited by the Regional Center for Tropical Biology (BIOTROP), an organization sponsored by the South-east Asia Ministers of Education Organization (SEAMEO), to teach in a weed science course at Bogor, Indonesia. The course is designed to provide young professionals with knowledge of research methods in weed science for use in their work with government agencies, universities, commercial farms, and plantations. Dr. Plucknett will be one of two Americans teaching the course.

Dr. Yoshinori Kanehiro, Professor of Soil Science, presented a paper at the "II Panel on Volcanic Soils of America" meeting which was held at the University of Narinno, Pasto, Colombia, June 18-24, 1972. After the meeting Dr. Kanehiro spent a week visiting and conferring with officials at CIAT in Cali, Colombia, at the International Soil Fertility Evaluation and Improvement Program in Guatemala.

Drs. Uehara and Fox will be participants in the AID-sponsored Tropical Soils Institute to be held at the University of Puerto Rico, July 10 to August 5, 1972. Other faculty participants are members of the Consortium. An intensive four-credit course, divided into the following sections--(1) soil classification, geomorphology, and climatology; (2) soil physics and mineralogy; (3) soil chemistry, fertility and water relations; and (4) soil management systems--is being offered. Student participants will be primarily composed of those from Latin American countries.

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and soil-water-plant research in the Mekong Delta. Since that time, Dr. Uehara has been awarded a one-year grant to study the composition of Mekong River silt and its possible role as a source of plant nutrient in the Delta. Actual work on this project should commence in the latter part of the year. From August 11-20, 1972 Dr. Uehara will participate in an organizational meeting in Saigon, Vietnam to discuss possible AID contracts involving the University of Hawaii and other state universities on agricultural potential of heavy clay delta soils.

Another grant possibility is a proposal submitted by Dr. L. D. Swindale to the AID on the relation of soil families to crop productivity in the tropics. This proposal is designed to classify the soil families of lesser developed countries and to acquaint agriculturalists in those countries with soil management and crop production practices developed for similarly classified soil families in Hawaii and the tropics.

Dr. W. G. Sanford spent two weeks as a pineapple consultant in the Ivory Coast, one week in October 1971 and one week in January 1972. He also spent two weeks in FAO, Rome and IFAC in Paris in June in preparation for a FAO-UNIDO pineapple mission in Madagascar. The mission was cancelled because of the political situation in Madagascar.

Following are students and faculty in the Department.

Graduate students [supported by State, East-West Center (U. S. State Department), Rockefeller and Ford Foundations, Country of Origin, FAO, etc.]

<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, Sylverius	Fall 70	D. Plucknett	Malaysia
Pellek, Richard	Fall 71	Y. Tamimi	U. S.
Saito, Ronald Y.	Spring 71	D. Bartholomew	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	Philippines
Ezumah, Humphrey	Spring 70	D. Plucknett	Nigeria
Floresca, Emmanuel	Fall 71	P. Rotar	Philippines
Guevarra, Anacleto	Fall 71	P. Rotar	Philippines
Nangju, Dimyati	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	Philippines
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
Nishina, Melvin S.	Fall 71	P. Rotar	U. S.
Periaswamy, Sirapalli	Summer 70	H. Ikawa	India
Santo, Lance T.	Summer 71	G. Uehara	U. S.
Syed Fadzil, Syed	Spring 70	J. Silva	Malaysia
Tianco, Antonio	Fall 70	D. Bartholomew	Philippines
Uchida, Raymond S.	Fall 71	Y. Tamimi	U. S.
Wambiji, Henry	Fall 69	S. El-Swaify	Kenya
<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	Pakistan

Graduate students (Cont.)

<u>Name</u>	<u>Arrival Date</u>	<u>Advisor</u>	<u>Home Country</u>
<u>Soil Science--Ph. D. (Cont.)</u>			
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 69	G. Uehara	U. S.

Research and teaching staff (supported by State funds)

<u>Name</u>	<u>Speciality</u>
<u>Soils</u>	
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
Leslie D. Swindale	Soil Genesis & Classification
Goro Uehara	Soil Physics, Mineralogy, Water Science
Roger T. Watanabe	Soil Testing
<u>Agronomy</u>	
Duane P. Bartholomew	Crop Physiology, Plant Nutrition
Richard Bullock	Tree Physiology
Ramon de la Pena	Root Crop Production, Crop Physiology
Peter P. Rotar	Plant Breeding, Cytogenetics
Wallace G. Sanford	Plant Nutrition, Physiology
Donald Plucknett	Crop Management, Weed Control
Yusuf N. Tamimi	Forest Soils, Nutrition
John R. Thompson	Crop Production
Ukio Urata	Plant Breeding
A. Sheldon Whitney	Plant Nutrition, Crop Physiology
Hong Yip Young	Plant Nutrition, Chemistry
Dennis Matsuyama	Research Associate
Ronald Yoder	Research Associate

Contractual

<u>Name</u>	<u>Title</u>
Charles Bower	Soil Scientist
Annie Chang	Jr. Researcher
Kishore Goswami	Jr. Soil Scientist
Marion Mapes	Asst. Agronomist
Helen Mishima	Research Associate
Douglas Nicholls	Jr. Agronomist
Santiago Obien	Jr. Agronomist
Ernest Okazaki	Jr. Soil Scientist
William Sakai	Asst. Soil Scientist
Gordon Shibao	Research Associate
Gordon Tsuji	Asst. Soil Scientist

Staff and students [supported by 211(d) funds]

<u>Position</u>	<u>Name</u>	<u>Speciality</u>
Soil Scientist	Charles Bower	Soil Chemistry
Jr. Researcher	Annie Chang	Analytical Chemistry
Graduate Res. Asst.	Niwat Hirunburana	Soil Fertility
Graduate Res. Asst.	Wayne Hudnall	Soil Mineralogy
Jr. Soil Scientist	Ernest Okazaki	Soil Chemistry & Mineralogy, X-ray Fluorescence Quantometer
Graduate Res. Asst.	Mayo Ryder	Soil Classification
Post Doctoral Fellow	William Sakai	Electron Microscope
Graduate Res. Asst.	Lance Santo	Soil Physics
Post Doctoral Fellow	Gordon Tsuji	Soil Physics
Graduate Res. Asst.	Raymond Uchida	Soil Chemistry

6. Other Resources for Grant-Related Activities: Largely through the impetus of Dr. R. Jones, the University of Hawaii, was awarded a \$77,000 NSF equipment grant from the purchase of a scanning electron microscope. Drs. Sakai, Jones and Uehara also received a Pacific Biomedical Research grant for \$26,000. This grant is for the purchase of an energy dispersive X-ray probe attachment for the scanning electron microscope. The grant will release AID funds for purchase of computer and software to take quantitative measurements with the X-ray probe. These instruments will be used in studies in soil mineralogy and on mechanisms involved in the uptake of nutrients by roots and leaves.

In teaching, Drs. Uehara, Green and Ikawa were awarded university academic innovation grant for \$9,466. This money was used to purchase

much of the audio visual equipment used in the two basic soils courses developed with AID support.

Support from private companies provided \$4,000 for the purchase of equipment to be used in AID-related studies.

These grants along with State and Federal funds for purchase of the X-ray fluorescence quantometer amount to over \$200,000 in equipment purchased with non-AID monies which are available to AID researchers.

Non-AID funds also provided for travel by Dr. W. G. Sanford to Italy, France, and the Ivory Coast, and by Dr. L. D. Swindale to Guam. Although not directly related to AID projects, these trips broadened the outlook of these researchers and established the basis for future consulting.

Resources of the University in terms of staff time were also used to handle many visitors that came to Hawaii for research and consulting or on short stops in travel between Asia and mainland U. S., including J. B. Aubert, IFAC, Cameroon; A. P. Barnett, ARS, Georgia; K. Kawai, Nat. Inst. Agri. Sci., Tokyo; L. D. Meyers, ARS, USDA, Western Region; E. Takahashi, Kyoto Univ.; T. L. Yuan, Univ. of Florida; and W. Wischmeier, ARS, Purdue.

7. Next Year's Plan of Work

7.1 Teaching and extension services: During the period of July 10-21, Dr. John Coulter of the Rothamsted Experiment Station is scheduled to present a series of seminars on international agriculture. In addition to individual consultation with the staff, Dr. Coulter with Drs. Uehara and Plucknett moderating, will hold an open discussion session with faculty and students on improving the agronomic and educational conditions in the tropics.

From July 10 to August 9, 1972, Drs. Fox and Uehara are planning to participate in the Tropical Soils Institute at the University of Puerto Rico. They will present a series of lectures in soil fertility, soil chemistry, soil physics and mineralogy. These lectures are intended to provide additional insight in the teachings and research on tropical soils at the University of Hawaii to students from Latin America. Plans have also been made for Drs. Uehara and Ekern of this department to participate in a soils workshop at Prairie View A&M College from October 2-6, 1972.

The success of the audio visual tutorial techniques in teaching the basic soils course in this department is reflected in the likely addition of five more audio visual tutorial units to the existing 11 and the installation of 10 more tape recorders in the Sinclair Library Listening Center. Continued use of these systems will be made by Drs. Ikawa and Green. Because of an increase in interest in electron microscopy, a new course entitled "Electron Microscopy in the Plant and Soil Sciences" will be offered by Dr. Sakai during the fall semester. This course will enable students in this department to gain competence in the use of the electron microscope to analyze mineralogical and biological specimens.

Additional topics will be presented in "Illustrative Concepts of Tropical Agriculture." To reiterate, these single page prints will be distributed in courses offered in this department and are available to members of the Consortium.

Based on the interest of other members of the Consortium, this department will propose to hold a two-week workshop for staff of the Consortium who are involved in soil mineralogy teaching and research

and related subject matter. With the availability of the X-ray fluorescence quantometer and the scanning electron with an energy dispersive X-ray probe attachment should make such a workshop very exciting.

7.2 Research: Work in soil mineralogy will concentrate in four areas: (1) investigation of the mineralogy of volcanic ash soils, (2) investigation of Hawaiian and Puerto Rican soils, (3) investigation of soils of the Pacific region, (4) transmission and scanning electron microscopy and electron probe analysis of selected tropical soil minerals.

General procedures to be employed follow. Soils derived from volcanic ash will be collected from Hawaii, Oregon, Japan, and Costa Rica. Electron microscopy and X-ray diffraction analysis of these soils will concentrate on the occurrence of imogolite and halloysite in attempting to determine factors involved in the formation of these two minerals. Electron microscopy and X-ray data of Puerto Rican soils will be compared with similarly classified Hawaiian soils. Of interest will be comparisons of the Tropeptic Eutrorthox of Puerto Rico (Bayamon and Matanzas) with that of Hawaii (Puhi), the Acrorthox of Puerto Rico (Nipe) with that of Hawaii (Kunuweia), and the Orthoxic Tropohumults of Puerto Rico (Cidra and Vicente) with that of Hawaii (Alaeloa, Halawa, Hamakuapoko, Ialeau, and Manana). Soils of the Pacific region which will be studied are primarily the Tongan soils and the delta soils of the Mekong River. The new scanning electron microscope with X-ray probe attachment will allow for the detection of elements in soil particles smaller than a micron in size. The same mineral particles studied with transmission electron microscopy and

scanning electron microscopy can thus be studied with the X-ray probe to determine the elemental composition. Initial studies will be on the mineral goethite which in Hawaiian and Puerto Rican soils apparently has much aluminum substitution. This aluminum substitution causes decreases in d-spacings and intensities with X-ray diffraction.

A preliminary report on the study of Tropical Histosols in Hawaii will be completed by Dr. H. Ikawa, who will be on sabbatical leave from January 1 through August 15, 1973 at the Soil Conservation Service, USDA in Fort Worth, Texas and in Oklahoma. In the interim, an investigation of Tongan soils is being initiated with the assistance of Mr. Andrew Rosenau.

Nitrogen adsorption, movement and transformation under varying redox conditions will continue to be of major interest to Dr. Kanehiro. Identification of the nitrogen-fixing bacteria so far isolated and determination of their contribution to total available soil nitrogen will be of concern to Dr. B. L. Koch. He will also undertake experiments to isolate and identify breakdown products from a mixed or pure culture of microorganisms which are able to utilize diuron, a herbicide, as a carbon source.

Soil physics research will be primarily involved in examining the phenomenon of soil-water hysteresis in Hawaiian Oxisols. Drs. Tsuji and Uehara are also planning studies to determine water infiltration rates into these soils. Additional investigations on the zero point of charge on the surfaces of Oxisols will continue. Along this line, Dr. S. El-Swaify is planning to continue his work on the charge characteristics of tropical soils and their implications to colloidal

stability and Dr. Green and Mr. P. S. C. Rao will pursue a research program on solute transport in Oxisols and Andepts. With the help of grants from USDA, Dr. El-Swify will initiate a conservation program designed to (1) study the erosive properties of agricultural tropical soils and (2) investigate the water-yielding and hydrologic characteristics of soils in forest watersheds.

With the addition of Dr. C. A. Bower, formerly director of the U. S. Salinity Laboratory in Riverside, California to the staff, a study on the chemistry and availability of major cations in relation to the macadamia is being planned. He will also have a major input into irrigation systems. Moreover, Dr. Bower will be available to lend technical assistance in the area of his expertise and experience to others in the department.

As part of the faculty exchange program, the AID grant will support, in part, the sabbatical leave of Dr. W. S. Reid from Cornell University. Dr. Reid will be working in association with Drs. Fox and Silva on a tentative program to determine lime requirements for tropical soils.

Dr. Fox will continue his studies on development of soil P for various tropical crops using the P-sorption method.

Drs. Fox and Sanford plan to spend one week in August visiting the Bougainville Copper Mine in Bougainville to determine if this department can give them help in the revegetation of road cuts, overburden waste piles and tailings which result from the mine operations. A long-range contract involving staff and graduate students is anticipated. Contacts were made with agricultural officials in New Guinea with the anticipation of cooperative work in the future.

8. Other: No additional comments.

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).

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

Object	211(d) Source			Non 211(d) Source ^b	
	Period Under Review	Cumulative Total	Projected Next Year		Projected to End of Grant
Research	\$72,377	\$ 92,890	\$ 97,500	\$325,000	\$590,650
Teaching	8,095	10,276	22,500	75,000	97,600
Libraries	146	185	7,500	25,000	10,000
Consultation	1,469	2,239	19,250	30,000	
Publication	600	1,300	19,250	30,000	10,000
Other	500	500		15,000	49,674 (Extension)
Total	\$83,187	\$107,390	\$166,000	\$500,000	\$757,924

^aThese figures are our best estimates

^b1971-72 estimated State, Hatch, Regional, NSF, NDEA, and other special grant funds (does not include fringe benefits on salaries)

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

Object	Actual Expenditures		Projected Expenditures			
	Period Under Review	Cumulative Total	Year			Total
			3	4	5	
Salaries & Wages (Total)	\$66,353	\$ 70,379	\$120,686	\$ 90,515	\$ 90,515	\$372,095
Salaries ^a	51,292	54,281				
Fringe Benefits	5,915	6,148				
Student Help	9,146	9,950				
Supplies (Total)	4,876	10,238	17,554	17,554	17,554	62,900
Supplies & Publications	4,730	10,053				
Library Acquisitions	146	185				
Equipment ^b (Total)	4,051	15,367	23,638			39,005
Travel (Total)	7,907	11,406	4,866	4,866	4,862	26,000
Inter-Island	1,781	3,500				
Out-of-State	2,275	4,055				
Foreign	3,851	3,851				
Total	\$83,187	\$107,390	\$166,744	\$112,935	\$112,931	\$500,000

^aFor salary breakdown for 1971-72, see Exhibit A

^bFor equipment expenditures for 1971-72 over \$100, see Exhibit B

Exhibit A: Individuals Under Salaries

<u>Name</u>	<u>Title</u>	<u>Date Employed</u>	<u>% of Time</u>	<u>Amount 7/1/71-6/30/72</u>
Bower, Charles	Soil Scientist	4/17/72	40	\$ 1,894.00
Sayegh, Antoine	Assoc. Soil Sci.	9/1/72	44	6,197.89
Sakai, William	Asst. Soil Sci.	9/1/71	100	9,243.50
Tsuji, Gordon	Asst. Soil Sci.	7/15/70	100	9,508.91
Chang, Annie	Jr. Soil Sci.	10/1/71	75	2,656.50
Okazaki, Ernest	Jr. Soil Sci.	1/17/72	100	4,971.43
Hirunburana, Niwat	Graduate Assistant	9/1/71	50	4,080.00
Hudnall, Wayne	Graduate Assistant	1/1/72	50	2,448.00
Osman, Abdel	Graduate Assistant	12/1/71	50	1,692.00
Ryder, Mayo	Graduate Assistant	1/1/72	50	2,448.00
Santo, Lance	Graduate Assistant	1/1/72	25	1,980.00
Shin, Han Poong	Graduate Assistant	11/1/71	50	1,903.50
Uchida, Raymond	Graduate Assistant	1/1/72	50	2,268.00
				<hr/>
				\$51,291.73

Exhibit B: Equipment Purchased Over \$100

<u>Vendor</u>	<u>Description</u>	<u>Cost</u>	<u>Justification</u>
Anderson's Camera House Honolulu, Hawaii	Nega file, 3 1/4 x 4" metal filing	\$ 161.70	Darkroom equipment for black and white and color photograph for 211(d)
Anderson's Camera House Honolulu, Hawaii	Omega voltage stabilizer	102.60	Same as above
Anderson's Camera House Honolulu, Hawaii	Arkay load master print washer	102.96	Same as above
Hastings B. Pratt Honolulu, Hawaii	Electrolux vacuum cleaner	197.08	Accessory equipment for X-ray quantometer
Ventures Associates Eleele, Kauai, Hawaii	4-draw file cabinet letter size	111.00	Office equipment
Central Camera, Inc. Honolulu, Hawaii	Camera tripod	217.07	Photographic equipment for soil comparative studies
Applied Research Lab. Sunland, California	Regulator transformer	990.00	Regulation of electrical power to quantometer
New Brunswick Scientific New Brunswick, N. J.	Portable gyrotory shaker	301.00	For growth of various micro- organisms in liquid culture
Van Waters & Rogers Honolulu, Hawaii	Incubator	686.40	For controlled temperature growth of microorganism; for growth and maintaining microorganisms under controlled temperature
Van Waters & Rogers Honolulu, Hawaii	Helium gas regulator oxygen regulatory	257.98	For use with newly purchased gas cylinders
Perkin-Elmer Corporation Norwalk, Connecticut	AA Micro sampling system	400.00	For micronutrient analysis of plants and soils
	Subtotal	\$3,527.79	
	Miscellaneous (less than \$100.00 per item)	522.79	
	Total	\$4,050.58	