AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

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BATCH #16

1. SUBJECT CLASSIFICATION

A. PRIMARY
Serials Y-AF00-1400-G302

B. SECONDARY
Agriculture--Plant production--Leguminous grains and vegetables--Latin Americ

2. TITLE AND SUBTITLE
Annual research report: Jan.1,1972 to Dec.31,1972

3. AUTHOR(S)
(101) USDA/ARS,Grain Legume Production (Latin America)

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1973	32p.	ARC 633.3.A278

7. REFERENCE ORGANIZATION NAME AND ADDRESS
USDA/ARS

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

9. ABSTRACT

10. CONTROL NUMBER
PN-RAA-929

11. PRICE OF DOCUMENT

12. DESCRIPTORS
Grain legumes
Latin America

13. PROJECT NUMBER

14. CONTRACT NUMBER
PASA RA(AJ)3-00 Res.

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

633.3
A278
1972

ANNUAL RESEARCH REPORT

GRAIN LEGUME PRODUCTION, PASA NO. RA(AJ)3-00

January 1, 1972 to December 31, 1972

Agricultural Research Service
Federal Experiment Station
Mayaguez, Puerto Rico

A.I.D.
Reference Center
Room 1656 N.

REPORT SUMMARY

A. 1. Project Title and Contract Number: Grain Legume Production, PASA No. RA(AJ)3-00.

2. Principal Contractor Representative, Contractor and Mailing Address: Dr. Walter Kaiser
Federal Experiment Station
Mayaguez, Puerto Rico 00708

3. Contract Period (as amended): June 25, 1963 to June 30, 1973

4. Period covered by Report: January 1, 1972 to December 31, 1972

5. Total AID funding of contract to date: $2,846,000

6. Total estimated expenditures and obligations for previous contract year: $249,000

7. Total expenditures and obligations authorized for current (FY 1973) year: $175,000

8. Estimated obligation and expenditure requirements for next contract year: $175,000

Note: Monetary estimates given above are expressed to the nearest thousand.

B. Narrative Summary of Accomplishments and Utilization.

Improved methods of screening bean (*Phaseolus vulgaris*) and Southern pea (cowpea) (*Vigna sinensis*) germ plasm to different important diseases are being tested and utilized in the greenhouse and field. Screening of Southern pea germ plasm has located several sources which contain multiple resistances to several diseases, including *Cercospora* leaf spot, bacterial blight, Puerto Rican cowpea mosaic virus, and powdery mildew. The etiology and biology of a newly identified bacterial disease of bean called "Tropical Halo Blight" is being studied. Tropical halo blight is one of the most important diseases of bean grown in the tropical lowlands.

A high yielding bean line called "La Vega" with resistance to *Rhynchosia* mosaic virus, bean common mosaic virus, rugose mosaic virus, and field resistance to root diseases and several races of rust present in Puerto Rico is in the process of being registered for release.

During the last year project personnel have made surveys of diseases affecting food legumes in several Latin American countries and have participated in various scientific meetings, workshops and seminars dealing with production of edible legume in the region.

ANNUAL RESEARCH REPORT

Grain Legume Production, PASA No. RA(AJ)3-00.

A. General Background

Many people in the world suffer from malnutrition either through shortage of calories or lack of proper balance of nutrients, or both. There is a growing recognition that insufficient or poor quality protein is one of the most important aspects of the total food deficiency problem. The problem is particularly severe for children and for pregnant and nursing mothers. Geographically, the problem is more severe in the tropical and sub-tropical areas where the populations are greatest and the people have the lowest purchasing power. Since the cost of animal protein is prohibitive, the bulk of the protein is obtained from plants, particularly cereals and other foods high in carbohydrates, but low in protein and certain amino acids. Thus, additional sources of better balanced protein are needed. This can best be provided by grain legumes, since they are higher in protein and have an amino acid composition that supplements the protein of the cereals. Furthermore, they are inexpensive, widely grown and accepted in tropical areas by the people with low incomes.

However, supplies of legumes in developing countries are insufficient to satisfy needs. Production levels of grain legumes are low due to low yield potential, damage from diseases and insects, and poor cultural practices.

One of the major factors limiting production of grain legumes are diseases and insects, particularly in the tropics. Control of

diseases and insects of beans (Phaseolus vulgaris) and Southern peas (cowpea) (Vigna sinensis) in developed countries has increased and stabilized production substantially. In the tropics it could have even greater impact since pests are more damaging. The least expensive and most efficient means of control is through development and introduction of resistant varieties. Consequently breeding for disease resistance is a major objective of the project headquartered in Puerto Rico.

B. Project Objectives

To produce germ plasm of beans and Southern peas resistant to diseases and insects causing major economic losses, or limiting production in tropical regions of Latin America and providing these sources of resistance to legume breeders in the region. To identify the diseases affecting food legumes in the tropics and determine their distribution and spread.

C. Continued Relevance of Objectives

Surveys of bean and Southern pea production areas of tropical Latin American countries during the last three and one half years substantiate the original proposition that diseases and insects are major factors contributing to the low and erratic production of these important food crops which makes the cultivation of these crops an uncertain endeavor.

D. Accomplishments to Date:

1. Findings:

a) A new bacterial disease of beans called "Tropical Halo Blight" which is particularly important in the lowland tropics of

Latin America has been identified and studies relating to its etiology and biology have been initiated.

b) The bean germ plasm collection of the Food Legume Improvement Project is being screened in the field and greenhouse to locate sources of resistance to tropical halo blight. A single hybrid line has been located which has resistance to tropical halo blight and possibly common bacterial blight.

c) A bean line called "La Vega" which is resistant to several diseases, including Rhynchosia mosaic virus is in the process of being registered for release.

d) Greenhouse studies have emphasized the importance of seed transmission of bacterial blights of bean and cowpea under tropical environmental conditions.

e) The inheritance of resistance to Puerto Rican cowpea mosaic is being investigated. The results suggest that resistance is governed by recessive factors. Several lines of Vigna sinensis appear to be immune to virus infection. F_2 and F_3 Southern pea hybrids are being screened in the field for resistance to this beetle transmitted virus. Field and greenhouse inoculation tests suggest that two different viruses are affecting Southern peas in Puerto Rico.

f) Two types of Cercospora diseases have been found infecting Southern peas in Latin America and Puerto Rico. These two diseases are differentiated by the symptoms which develop on infected leaves and on the differences in conidia and conidiophore morphology. Some Cercosporas isolated from different cultivated and weed hosts are pathogenic V. sinensis in greenhouse inoculation trials and indicate the importance of alternate hosts as reservoirs of the pathogen.

Several cowpea lines have been developed which possess resistance to both Cercospora diseases, and some lines are also resistant to Corynespora leaf spot (C. cassiicola).

g) A collection of 1740 bean lines from the germ plasm collection of the Escuela Agrícola Panamericana, El Zamarano, Honduras is being screened for disease resistance.

h) Disease surveys have been made in several Latin American countries. These surveys have showed that smut (Entyloma sp.) of bean is present in Haiti, and could become a potential threat to the cultivation of food legumes if it is ever introduced into the United States.

i) The greenhouse and field screening procedures utilized by the legume project have eliminated the importance of bean common mosaic virus (BCMV) as a limiting disease in the advanced breeding lines. Resistance to BCMV is routinely incorporated into lines which are being screened against different diseases.

j) Thirty bean lines have been found which are immune to the races of rust which occur in Puerto Rico.

k) A more detailed report of findings is given in Appendix A.

2. Interpretation of Data and Supporting Evidence:

Puerto Rico:

During the 3 1/2 year period the project has been in operation, results indicate that germ plasm of beans and cowpeas can be identified by growing large numbers of lines of diverse origin under conditions of natural epidemics to diseases in tropical environment in Puerto Rico and then subjecting the field resistant lines to further screening under more controlled conditions in the greenhouse. Subsequent evaluation of several of these lines in Central America tend to confirm the hypothesis

that germ plasm resistant to a given disease in Puerto Rico will be resistant also in Central America. Thus, a program for development of resistant germ plasm for Latin America can be successfully carried out from a U.S.-based tropical location such as Puerto Rico.

3. Research Design:

There will be little change in the research methods that have been utilized by the project. New or different techniques will be incorporated into our research program when they will enhance the progress of our research. Greatest emphasis will be devoted to the study of diseases of most importance to the cultivation of beans and Southern peas in the tropical areas of Latin America, and developing germ plasm of these crops which is resistant to these limiting diseases.

E. Dissemination and Utilization of Research Results

1. Dissemination of Results:

Results of research have been published in scientific journals and presented orally to various scientific meetings and technical conferences (see Appendix B, List of publications and oral presentations and participation in technical conferences). Germ plasm has been widely disseminated to food legume workers throughout the world (see Appendix C, Dissemination of Germ Plasm During 1972.

2. Examples of the Use of Findings:

One bean line, "La Vega" which was found by Project personnel to have resistance to several diseases, including *Rhynchosia* mosaic virus is being tested in several countries of Latin America. Germ plasm developed by the project has been requested by different legume researches in the tropics to be included in their field trials.

See Appendix D for details.

3. Expansion of Use of Findings:

Experience from the project in Iran indicates that it is necessary to have continuing close working arrangements with legume improvement workers and with administrators responsible for funding legume research in each country. Accordingly, great effort has been expended to develop such arrangements. Close working relationships have been established with the coordinator of the PCCMCA Central American Uniform Legume Tests to provide additional entree into the Central American countries. In addition, contacts have been established with researchers from the International Research Centers in Colombia and Nigeria. A continuing effort also has been made to keep local AID mission personnel well informed and to seek their advice and cooperation. These activities can be carried out under the current provisions of the contract.

4. Involvement of LDC Personnel and Institutions

1. Disease surveys conducted by project personnel in various Central American countries have made technicians working with legumes in these areas more aware of the importance of diseases in legume cultivations. As a result, they are now screening legume breeding material against important plant diseases, and are implementing disease control programs.

2. Legume project personnel have helped to design experiments in legume improvement, disease and pest control, etc., which have been implemented subsequently by legume technicians in some Central American countries.

3. Improved lines of bean and Southern pea developed by the project have been requested by researchers in various countries of Latin America to be tested under the conditions prevailing in these areas.

5. Copies of Publications, Seminar Reports, etc.

Copies of scientific publications, trip reports, seminar presentations, etc., are available upon request.

F. Statement of Expenditures and Obligations and Contractor Resources

G. Work Plan and Budget Forecast for the Coming Year

1. Anticipated Accomplishments for the coming year:

a. Identify the causal agent of "Tropical Halo Blight" which is a serious bacterial disease of beans in the tropical lowlands of Latin America.

b. Determine the importance of seed transmission and insect vectors in spread of bacterial blights of bean and cowpea.

c. Identify the *Cercospora* species causing two diseases of Southern pea in Puerto Rico and Latin America.

d. Study the importance of alternate hosts in the spread and survival of *Cercospora* species affecting *Vigna sinensis*.

e. Release one bean variety resistant to *Rhynchosia* mosaic virus.

f. Release three cowpea varieties resistant to Puerto Rican cowpea mosaic virus.

g. Publish results of research on tropical halo blight and resistance to Puerto Rican cowpea mosaic virus.

2. Procedures to be Used and Activities to be Carried Out:

a. Mass screening of bean and Southern pea germ plasm will be continued in the field with available and newly acquired germ plasm. Different methods will be used in the greenhouse to screen advanced lines against various diseases.

b. Various techniques will be utilized to increase the percentage of bean and Southern pea crosses that produce seed. These studies will be done in the greenhouse.

c. In cooperation with the University of Puerto Rico, screening of bean lines for resistance to whitefly transmitted viruses under

conditions optimum for disease spread and development will be studied.

d. The importance of alternate hosts of bacteria, fungi and viruses affecting food legumes will be determined. Inoculation tests will be conducted with these organisms to determine their pathogenicity to beans and cowpeas.

e. Different techniques will be used to induce sporulation of fungal pathogens, particularly Cercospora species which generally sporulate poorly in pure culture. A large supply of spores is needed in field and greenhouse screening trials.

f. The importance of seed and insects in the transmission of bacterial blight of bean and Southern pea will be investigated in the laboratory, greenhouse and field.

3. Factors Promoting or Impeding Accomplishments:

In the project budget for FY 73 funds had been allocated to hire a laboratory assistant for Dr. Kaiser. However, due to the USDA freeze on employment we have been unable to fill this position. Dr. Kaiser has been without assistance in the laboratory since being transferred to the Puerto Rican legume project in December, 1971.

Additional field and greenhouse help are needed if we are to continue maintaining our gene bank and to screen bean and Southern pea germ plasm for new sources of resistance.

In Puerto Rico due to the tropical climate, our field work activities extend over a 12-month period. During this time 3-4 crops are planted. However, without sufficient field labor, we are encountering difficulties in the seeding, maintaining and harvesting of these different plantings.

During the year we have encountered difficulties in obtaining bean crosses for the specific purpose of studying inheritance of resistance to Rhynchosia mosaic virus and other diseases due primarily to high temperatures encountered in the greenhouse. Various methods have been tested to resolve this problem without success. We are now in the process of installing a water cooler to see whether the daytime temperatures in the greenhouse can be reduced sufficiently to increase seed set.

4. Dissemination and Utilization of Research Results:

a. Publication of results in scientific journals, popular journals, and annual reports.

b. Results of disease surveys which are made periodically of tropical bean and cowpea growing areas of Latin America are published in trip reports, scientific journals or presented at meetings.

c. Through meetings and conferences which the project staff participate in, such as the PCCMCA and Phytopathology meetings and in-country workshops.

d. Discussions with legume technicians from various countries which occur when trips are made to these areas in connection with project activities.

e. In field trips that are made with legume technicians within their countries. These trips are also a training session for these technicians where many factors of legume production are discussed including disease identification, distribution and control.

f. Through dissemination of improved germ plasm to legume breeders in the tropical countries of Latin America.

5. Budget Statement for FY 1974:

Attached. (Appendix F).

H. Appendices

A. Report of Progress, July 1, 1972-December 31, 1972.

B. List of Publications and Oral Presentations and Participation in Technical Conferences.

C. Dissemination of Germ Plasm During 1972.

D. Examples of the Use of Findings.

E. Budget for Fiscal Year 1973.

F. Budget Statement for Fiscal Year 1974

Progress Report, July 1, 1972-December 31, 1972.

Beans (*Phaseolus vulgaris*)

Resistance to Tropical Halo Blight

A number of dull-black seed putative hybrids of PI accessions obtained in 1969, showed field resistance to tropical halo blight and common bacterial blight during 1970 and 1971 trials.

Thirty one field resistant hybrid lines were selected for a primary greenhouse screening. Seeds were divided into two lots of 30 each for inoculation with culture #85 obtained from Southern peas infected with bacterial blight and canker (*Xanthomonas vignicola*) which appears to be the cause of tropical halo blight of beans and culture 86-1, obtained from a common bacterial blight (*X. phaseoli*) lesion from the bean variety "Black Valentine". Results indicated that nine hybrid lines segregated for susceptibility to culture #85 while one, 71-1-R199, was resistant. The same hybrid also segregated to 5 moderately susceptible to 21 resistant to common bacterial blight culture #86-1. Hybrid 71-1-R199 has a bush habit, purple pinto seeds and stringless pods. It is an F_4 progeny selection from a dull black hybrid obtain from the maternal parent PI 207203 which originated from Colombia.

Rust Resistant Selections and Hybrids

There are 30 line selections of beans from PI accessions which have proved immune ("0" type response) in repeated field inoculations from 1970 to 1973. There are also 80 black-shiny bean seed hybrids which have been resistant to rust (*Uromyces phaseoli* var. *typica*). None of the rust differential varieties used in the Continental United

States have survived in our field trials in Puerto Rico without fungicide sprays.

Southern peas (*Vigna sinensis*)

Bacterial canker resistance

Field and greenhouse inoculation trials with bacterial blight and canker (*Xanthomonas vignicola*) have produced twenty one resistant lines. These lines were selected from a total of 503 PI accessions tested. These selections are highly resistant, i.e., no leaf or stem lesions resulted from inoculations in the greenhouse. By contrast, all the susceptible plants used as standards died due to the bacterial infection. The selection numbers of these resistant lines are: 70-4-R-9, -14, -40, -44, -48, -91, -95, -97, -99, -105, -106, -107, -118, -445, -439, -438, -[illegible], -463, -464, -465, and -446.

Cercospora Leaf Spot Resistance

Two different *Cercospora* leaf spot (CLS) diseases affect *Vigna sinensis* in Puerto Rico and tropical regions of Latin America. During the rainy season a susceptible variety could be defoliated due to CLS infection before its pods had matured. Extensive field inoculations of replicated trials have resulted in the selection of thirteen lines which are resistant to both *Cercospora* diseases. There were a number of lines which were obviously susceptible to one type or the other. But to screen for resistance to one disease while the inoculum for the other is also present in the field, may result in unsatisfactory selections. The list of the resistant lines to both species include: 70-4-R-111, -120, -173, -33, -253, -256, -373, -379, -286, -482, -95, -268 and -349.

Five of the Cercospora resistant lines were also resistant to target spot caused by Corynespora cassiicola. These were: 70-4-R-95, -120, -268, -286 and -349.

Cercospora Leaf Spot of Vigna sinensis

Cercospora leaf spot is an important disease of Vigna sinensis in many regions of tropical Latin America, especially where there is abundant rainfall and humidity during part of the growing season.

Techniques have been developed to isolate the pathogen from diseased plant tissues and grow the fungus in pure culture. Two distinct types of Cercospora have been isolated from V. sinensis which vary in the symptoms produced on this host and in the size and shape of the conidia and conidiophore.

The pathogenicity of isolates of Cercospora from different hosts to V. sinensis is being studied in the greenhouse. Various techniques are being used to inoculate Southern pea and other plants with Cercospora isolates. Some of the Cercospora isolated from different hosts are pathogenic to V. sinensis (Table 1), emphasizing the importance of alternate hosts in the spread and survival of these pathogens to cowpea in the tropics.

Table 1 - Pathogenicity of isolates of *Cercospora* from different hosts to *Vigna sinensis*. Inoculations were done in the greenhouse at Mayaguez, Puerto Rico.

Cercospora Isolate	Pathogenicity to *Vigna sinensis* a/
Vigna sinensis (gray lesion type)	+++
V. sinensis (brown lesion type)	+++
Ipomoea learii	+++
Ricinis communis	+
Bidens pilosa	-
Zebrina pendula	-
Mucuna sp.	-
Calopogonium sp.	-

a/ Extent of lesion development: +++, heavy; ++, moderate; +, slight; -, none.

Puerto Rico Cowpea Mosaic Virus

Mass inoculations of *Vigna sinensis* seedlings obtained from siblings and crossing resistant and susceptible lines indicated resistance was governed by recessive factors. Highly resistant lines such as 70-10-R-58 and -61, and immune lines such as 70-10 -R-1 and -3 were developed.

Bacterial Blights of bean and Southern pea.

Numerous isolations have been made from diseased bean, Southern pea and other plant species which exhibited symptoms of bacterial infection. All bacterial isolates which proved to be pathogenic to beans and Southern pea in greenhouse inoculation tests were *Xanthomonas* types forming yellow, butyrous colonies on nutrient agar medium.

Insects were collected from bean fields heavily infected with bacterial blight and were placed in sterile water or on healthy bean and Southern pea plants in large insect cages. Bacterial isolations were made from wash water of the different insects and from lesions on plants which developed at the feeding sites of these insects. Bacteria pathogenic to bean and Southern pea were isolated from several insects, especially *Cerotoma ruficornis* (bean leaf beetle) and *Diaprepes abbreviata* (sugar cane weevil root stalk borer).

Greenhouse tests confirmed that the bacterial blights of bean and Southern pea were seed-borne in these hosts and that seed transmission is one of the most important methods of survival and spread of these pathogens.

Publications

Kaiser, W.J. 1972, Occurrence of three fungal diseases of chickpea in Iran. FAO Plant Prot. Bull. 20:73-78,98.

Abstract: In 1969, an epiphytotic of foliar and stem diseases of chickpea (*Cicer arietinum*) occurred in yield trials in Southwestern Iran. The foliar diseases were caused by *Ascochyta rabiei* and *Stemphylium sarciniforme* and the stem and crown blight by *Sclerotinia sclerotiorum*. These diseases were favored by the unusually high rainfall which occurred in this region during the spring of 1969. One black-seeded line was found to be resistant to *A. rabiei* which is one of the most important foliar pathogens of chickpea in many regions of the Middle East and Southeast Asia.

Kaiser, W.J., M. Okhovat and G.H. Mossahebi. 1971. *Pythium aphanidermatum*, an important pathogen of peas (*Pisum sativum*) in Khuzestan, Iran. Iranian J. Plant Pathology 7(1):1-3 (In Farsi with an English Summary). Issued March, 1972.

Abstract: Soil-borne diseases caused by *Pythium* species are widely distributed in Iran affecting numerous important food crops, including food legumes. *Pythium aphanidermatum* was found to be the cause of a serious damping-off and root rot disease of pea (*Pisum sativum*) in Southwestern Iran. Isolates of *P. aphanidermatum* from various hosts and different regions of Iran were highly pathogenic to pea and other edible legumes in greenhouse pathogenicity tests. Treatment of seeds with Captan and Arasan increased greatly the emergence and survival of peas planted in infested field soil.

Kaiser, W.J., G.H. Mossahebi and M. Okhovat, 1971. Alternate hosts of viruses affecting food legumes in Iran. Iranian J. Plant Pathology 7(2):25-28. (In Farsi with an English Summary). Issued May, 1972.

Abstract: Numerous diseases affect food legumes in Iran, and are often a limiting factor in the cultivation of these crops. Some of the most important diseases of edible legumes in Iran are caused by viruses. Seven viruses were identified as infecting one or more pulse crops in Iran. These were alfalfa mosaic (AMV), bean common mosaic (BCMV), bean yellow mosaic (BYMV), cowpea aphid-borne mosaic (CAMV), cucumber mosaic (CMV), pea enation mosaic (PEMV) and pea leaf roll (PLRV). All viruses were transmitted by several different species of aphids which commonly colonized pulse crops and some are seed-borne. Several viruses infecting food legumes were isolated from numerous annual and perennial plants growing within or adjacent to pulse plantings in various areas of Iran. Plants in 16 families were hosts of one or more viruses affecting pulses. CMV which had the largest host range infected plants in 35 genera from 15 families.

Kaiser, W.J., D. Danesh, M. Okhovat and G.H., Mossahebi, 1972. Virus diseases of pulse crops in Iran. Bulletin published by College of Agriculture, University of Tehran, Karaj. 111p.

Abstract: This bulletin presents information and photographs of virus diseases which affect food legumes in Iran. The pulse crops cultivated in Iran are chickpea (Cicer arietinum), lentil (Lens esculenta), mungbean (Phaseolus aureus), bean (Phaseolus vulgaris), pea (Pisum

sativum), broadbean (Vicia faba) and cowpea (Vigna sinensis). Seven viruses were found to infect pulses in different regions of Iran. Host range, symptomatology, transmission, vectors, and alternate and over wintering hosts of these viruses are described.

Oral Presentations

Paper entitled "Seed Transmission of Bean Yellow Mosaic Virus in Broadbeans in Iran" was presented by W.J. Kaiser at the 64th Annual Meeting of the American Phytopathology Society which was held in Mexico City from August 6-12, 1972.

Paper entitled "Distribution of bean (Phaseolus vulgaris) smut (Entyloma) in Central America" was presented by N.G. Vakili at the 64th Annual Meeting of The American Phytopathological Society which was held in Mexico City from August 6-12, 1972.

Dr. Vakili presented papers by N.G. Vakili and D.W. Walker entitled "Varietal Susceptibility of Cowpeas to Pod Borer," "Differences in Susceptibility of Bean Varieties to Pega Pega," and "Bean Pod and Seed Damage by Bean Pod Borer" at the Caribbean Food Crops Society Meeting held in Mayaguez, Puerto Rico from June 11-17, 1972.

Dr. Vakili presented a paper by N.G. Vakili and J. Santiago, entitled "Mass Screening of Vigna sinensis seedlings for Resistance against Puerto Rico Cowpea Mosaic Virus" at the 32nd Annual Meeting of the Sociedad Americana de Ciencias Agrícolas held at the Agricultural Experiment Station, Rio Piedras, Puerto Rico on October, 13, 1972.

Dr. Vakili will present papers entitled "Wild Hosts of Whitefly Transmitted Viruses in Tropical Americas," and "Tropical Halo Blight of Beans" at the 19th Annual Meeting of the PCCMCA (Programa Cooperativo Centroamericano para el Mejoramiento de Cultivos Alimenticios) which will be held in San José, Costa Rica from March 5-8, 1973.

Participation in Technical Conferences, Workshops, etc.

Drs. Vakili and Kaiser presented papers at the 64th Annual Meeting of the American Phytopathological Society held in Mexico City from August 6-12, 1972.

In August, 1972 Dr. Kaiser was invited by the Instituto Colombiano Agropecuario (ICA) to observe and evaluate the chickpea (*Cicer arietinum*) and lentil (*Lens esculenta*) germ plasm trials established by ICA at the Tibaitata Experiment Station near Bogotá, and to survey the diseases affecting these crops at Tibaitatá and the Departamento de Boyacá.

DISSEMINATION OF GERM PLASM DURING 1972

1. Six accessions of black-seeded bean (*Phaseolus vulgaris*) and two accessions of Southern pea (*Vigna sinensis*) were sent to Ing. Heleodoro Miranda M., Instituto Interamericano de Ciencias Agrícolas de la OEA, Zona Norte, Apartado 1688, Sucursal 1, San Salvador, El Salvador.

2. Fifty four accessions of Central American bean varieties were sent to Dr. Frank Kuu, Nuclear Center, University of Puerto Rico, Mayaguez.

3. Forty six accessions of chickpea (*Cicer arietinum*), 56 accessions of lentil (*Lens esculenta*), thirty two accessions of broadbean (*Vicia faba*), and seed of seventeen virus test plants were sent to Dr. Marco A. Castillo, Departamento de Agronomía, Instituto Colombiano Agropecuario, Apartado Aéreo 7984, Bogotá, Colombia.

4. Twenty one accessions of Southern pea with resistance to four different pathogens were sent to Dr. Robert J. Williams, International Institute of Tropical Agriculture, Oyo Road, P.M.B. 5320, Ibadan, Nigeria.

5. Nine accessions of red bean were sent to Dr. R.E. Pierre, Plant Pathologist, Faculty of Agriculture, University of The West Indies, Mona, Kingston 7, Jamaica.

6. Seven accessions of bean and two accessions of Southern pea were sent to Mr. Kueneman, Hospital Albert Schweitzer, P.O. Box 2213-B, Port-au-Prince, Haiti.

7. Two accessions of bean varieties La Vega (R-19) and Santa Ana were sent to Dr, A.V. Schoonhoven, Assistant Entomologist, Centro Internacional de Agricultura Tropical, Apartado Aéreo 67-13, Cali, Colombia.

SE OF FINDINGS

1. In visits to Central American countries by Project personnel, several legume research technicians from each country have been trained in field diagnosis of diseases affecting beans and cowpeas. Also, suggestions have been made on methods of designing experiments for screening and selection of breeding material against plant diseases and insect pests. These suggestions have been used by technicians in some of these countries in the design and execution of their legume experiments. "On-the-Job-Training" is an important aspect of the Legume Project's work.

2. Bean lines which were found by the Legume Project to be resistant to the whitefly-transmitted Rhynchosia mosaic virus are being tested in several Central American countries. Lines resistant to the virus in Puerto Rico are also resistant to the virus in Central America. One of these virus resistant bean lines is being registered for release under the name "La Vega". It also has resistance to bean common mosaic virus, rugose mosaic virus, and field resistance to root diseases and several races of rust prevalent in Puerto Rico.

3. Legume research workers in several Latin American countries have participated with project personnel in surveying legume plantings for diseases, and are now able to do some of the disease survey work themselves.

4. Cowpea lines developed by the project which are resistant to several diseases, including Puerto Rican cowpea mosaic virus, Cercospora leaf spot, bacterial blight and powdery mildew are being tested in field trials in El Salvador.

AID-2-3 (6-64)

PASA BUDGET PLAN By Object Class

PARTICIP/ · AGENCY SERVICE AGREEMENT
WITH:
U.S. Department of Agriculture
Agricultural Research Service (Grain Legume)
BUDGET PLAN FOR FY 1973

AMOUNT: $175,500
APPROPRIATION 72-1131004
ALLOTMENT 354-31-099-00-22-31

PASA CONTROL NO. RA(AJ)3-00
PIO/T NO. 931-17-130-029-72-3137556

Position	Class. Grade	GS ~~PQX~~ Grade	Rate	Man ~~Years~~ Months	Salary	Differential	11 TOTAL	12 Personnel Bene*	21 Int'l.* Travel	22 Transportation of Things Storage, HHE	TOTAL
Plant Pathologist											
Kaiser, Walter J.		13/6	22,985	12	22,401	1,120	23,521	1,904	2,000 a/		27,425
Plant Pathologist											
Vakili, Nader G.		12/10	21,686	12	21,144	1,057	22,201	1,797	5,900 b/		29,898
Research Technician											
Santiago-Medina, Wm.		7/1	9,520	12	9,144	457	9,601	777			10,378
Technical Asst.(biology)											
Santiago-Rosado, J.A.		4/1	6,882	12	6,712	336	7,048	571			7,619
Technical Asst.(biology)		4/1	6,882	3	1,721	86	1,807	146			1,953
Clerk Typist											
Busquets Mireya		2/3	5,794	12	5,652	283	5,935	480			6,415
Crop Research Helper											
Valentin Rupizar, Americo		1/1	4,798	12	4,675	234	4,909	397			5,306
Herrera F. Sigfredo		1/1	4,798	9	3,887	194	4,081	330			4,411
L/A Labor, including WB employment				13	4,854		4,854				4,854

a/Home leave, including travel within U.S. (Davis and Berkeley, California) to visit bean breeders and pathologists and consultations in Washington/Beltsville to consult with AID/USDA officials.

b/For either Vakili or Kaiser: local travel within Puerto Rico; travel to Mexico to attend American Phytopathological meetings from August 6-12, 1972, and to visit bean growing areas in Southern Mexico to complete the disease survey of pulse growing regions in tropical Central America. One trip to Central America during the course of fiscal year for continuation of work with PCCMCA in connection with Central American bean and cowpea improvement programs; another such trip to extend into South America for contacts with scientists working in pulse programs and visit CIAT.

c/Includes cost of supplies, materials, and equipment of specialized nature available from limited USDA Procurement sources.

*Estimated Per Diem: $3,500

ARS/IPD 3/19/73

TOTAL	98,259
22 Trans. of things	6,000
23 Rent, Communications, Utilities	350
25 Other services	6,800
26 Supplies and Materials	4,000 c/
Equipment	37,200
Sub-total	152,609
Overhead 15 %	22,891
GRAND TOTAL	175,500

REVISED BUDGET FOR REMAINDER OF FY 1973
FOR
SERVICES, SUPPLIES AND EQUIPMENT

REGIONAL FOOD LEGUME IMPROVEMENT PROJECT
USDA/AID
PASA RA (AJ)3-00

FEDERAL EXPERIMENT STATION
Mayaguez, Puerto Rico

OTHER SERVICES (Maintenance)		
Vehicles, tractors and other machines	1,800	
Irrigation and water facilities	500	
Greenhouse and other facilities, housing, supplies and equipment for project	4,500	
		6,800
SUPPLIES		
Glassware, laboratory chemicals and supplies, fungicides, insecticides, fertilizers, seed envelopes, paper and plastic bags etc.	4,000	4,000
EQUIPMENT		
4-door truck (as indicated in earlier budget estimate)		3,200
Seed Storage Facilities (some seed storage facilities being constructed with other funds)		6,000
Seed Cleaning and Seed Treating facilities		3,000
Tractor-Drawn spray outfit with accessory equipment		2,000
Irrigation pipe and spray nozzles		1,500

cont'd - Revised Budget (FY-1973)

Zeiss compound microscope with apochromatic lenses and camera attachment (Original estimate did not cover items requested and required)	4,500
Constant temperature and Humidity Growth Chambers	14,000
Other non-expendable items, such as BOD incubators, precision balance, pH meter, etc. which are needed for our research studies in the laboratory and greenhouse	3,000
	$48,000

AID-2-3 (6-64)

PASA BUDGET PLAN By Object Class

PARTICIPATING AGENCY SERVICE AGREEMENT
WITH:
U.S. Department of Agriculture
Agricultural Research Service (Grain Legume)
BUDGET PLAN FOR FY 1974

AMOUNT: $175,000
APPROPRIATION
ALLOTMENT

PASA CONTROL NO. RA(AJ)3-00
PIO/T NO.
Page 1 of 1 Pages

Position	Class. Grade	GS ~~FX~~ Grade	Rate	Man ~~XXXX~~ Months	Salary	Differential	11 TOTAL	12 Personnel Benefits	21 Int'l.* Travel	22 Transportation of Things	TOTAL
Plant Pathologist Kaiser, Walter J.		13/6	22,985	12	22,985	1,149	24,134	1,954	12,500 a/		38,588
Plant Pathologist Vakili, Nader G.		12/10	21,686	12	21,686	1,084	22,770	1,843	3,000 b/		27,613
Research Technician Santiago-Medina, Wm.		7/2	9,837	12	9,796	490	10,286	832			11,118
Technical Asst. (biology) Santiago-Rosado, J.A.		4/1	6,882	12	6,882	344	7,226	585			7,811
Biological Lab. Technician		5/1	7,694	12	7,694	385	8,079	654			8,733
Biological Aide		1/1	4,798	12	4,798	240	5,038	408			5,446
Clerk Typist Busquets Mireya		2/3	5,794	12	5,794	290	6,084	492			6,576
Crop Research Helper Valentin Rupizar, Americo		1/1	4,798	12	4,798	240	5,038	408			5,446
Herrera F. Sigfredo		1/1	4,798	12	4,798	240	5,038	408			5,446
Supervisory Travel - 2 trips							2,200				2,200
L/A Labor, including WB employment				13			5,000				5,000

a/Local travel within Puerto Rico and U.S. International travel - one trip to Brazil, Colombia and possibly other South American countries, two trips to Central America, and one trip to Nigeria and other West African countries. Travel to be performed by the two plant pathologists assigned to this project.

b/Home leave, including travel within U.S. to visit legume research workers.

TOTAL	123,977
22 Trans. of things	2,600
23 Rent, Communications, Utilities	397
25 Other Services Pub. & Journals.	8,700
26 Supplies and Materials	6,500
31 Equipment	10,000
Sub-total	152,174
Overhead 15 %	22,826
GRAND TOTAL	175,000

*Estimated Per Diem:
ARS/IPD 3/19/73

GPO 889-965

REGIONAL FOOD LEGUME IMPROVEMENT PROJECT
USDA/AID
PASA RA(AJ)3-00

BUDGET ESTIMATE FY-1974

OTHER SERVICES (Maintenance)	
Vehicles, tractors and other machines	2,300
Irrigation and water facilities	800
Greenhouse and other facilities, housing supplies and equipment for project	4,900
	8,000
TRAVEL	
Local (within Puerto Rico and U.S.)	2,500
International	
Trips to be made by Drs. Kaiser and Vakili	
Two trips to Central American countries for continuation of work with PCCMCA in connection with Central American bean and cowpea improvement programs. One trips will be made in the Fall of 1973 and the other in the Spring of 1974. During the Fall trips, Drs. Kaiser and Vakili will also participate in the Caribbean Division Meetings of the American Phytopathological Society being held in San Jose, Costa Rica (exact date of meeting not known).	3,500
One trip to Brazil, Colombia, and possibly other South American countries to become acquainted with the food legume improvement programs in the different countries (especially at CIAT, Cali, Colombia), to initiate cooperative studies with various legume research groups, and to survey for diseases of food legumes.	2,500
One trip to Nigeria and other West African countries to visit the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria, to observe and evaluate the performance of improved lines of cowpea developed by the USDA/AID Food Legume Improvement Project which are being tested by IITA in their field trials, and to consult with scientists at IITA and other West African countries who are working on the improvement of food legumes for the humid, lowland tropics. This trip will be made to coincide with	

a food legume improvement workshop which will be held at IITA (exact date not known).	4,000
HOME LEAVE	
Home leave for Dr. Vakili and family to Illinois with some TDY for Dr. Vakili to visit legume research workers in the U.S.	3,000
PUBLICATIONS AND JOURNALS	
Page and reprint costs for publication of research results in scientific journals.	400
Subscription to scientific journals and purchase of research books.	300
EXPENDABLE SUPPLIES AND MATERIALS	
Glassware, laboratory chemicals and supplies, fungicides, insecticides, fertilizers, seed envelopes, paper and plastic bags.	6,500
EQUIPMENT	
Seed cleaning and seed treating equipment	3,000
Other non-expendable items, such as irrigation pipe, pesticide sprayers, shaker, refrigerator, etc. which are needed in our research studies in the laboratory, greenhouse and field.	7,000