Proj. No. 9310560-
PN
PD-AAC-820-B1
(2)

PROJECT STATEMENT

22p

I. Project Summary

A. Statistical

Project Title:	Development of Improved Varieties of Soybeans and Supporting Cultural and Marketing Practices for Production in the Tropics, and Information Delivery Systems
New or Extension:	Extension
Contractor:	University of Illinois, Urbana, Illinois, 61801, College of Agriculture, University of Puerto Rico, Mayaguez, Puerto Rico (under subcontract)
Principal Investigator:	Dr. William N. Thompson
Duration:	Three years, April 1, 1976 to March 31, 1979
Funding to Date:	$980,605 to March 31, 1976
Total Estimated Cost:	$2,332,865 to March 31, 1979
Funding by Fiscal Years:	1976 - $738,430 1977 - $783,805 1978 - $810,630
Project Manager:	Willard H. Garman (temporary)

B. Narrative Summary

In April 1973, a contract was awarded to the University of Illinois at Urbana-Champaign (UIUC) by the Agency for International Development, calling on the University to "perform a research and development program directed toward the development of improved varieties of soybeans". The scheduled completion date was March 31, 1976.

This Project Statement addresses itself to the realignment of the research contract, progress to date, and objectives for the five-year period, April 1, 1976 to March 31, 1981.

Adoption of this proposal will facilitate continuation of activities begun under the existing research contract and will permit greater attention to be given to necessary efforts in pest management, storage and handling of soybean seed, marketing economics, and dissemination of information.

The College of Agriculture's International Soybean Program, INTSOY, in cooperation with the University of Puerto Rico, will conduct a research and development program directed toward the development and production of improved varieties of soybeans in LDCs. The objectives of predecessor contracts AID/CSD 3292 and AID/CM/ta-c-73-19 will be modified and expanded as indicated. The scope and method of work will continue the successful pattern employed under the referenced contracts.

Research will continue on the screening and evaluation of lines and selections of soybeans for yield, nutritive quality, climatic adaptability and resistance to diseases and insects. Close cooperation will be maintained with international and regional research centers as well as national research organizations in all of these endeavors. Complementary activities of an AID-sponsored 211(d) program will be integrated with work under this contract, especially in the area of utilization of soybeans as human food.

C. 4 x 4 Matrix

II. Project Description and Background

A. Purpose

The purpose of this project is to help solve problems which now inhibit the production of the soybean as a major source of human food on a worldwide basis. These problems include those affecting the yield of the plant, its adaptation, and various technological and social factors affecting its direct use as food.

B. Problem

With the cost of animal protein rising even faster than the average yearly earnings of the people in the developing countries, the possibilities of meeting minimum protein requirements with animal products are remote. It is generally conceded that if we are to narrow this gap, which is a major key problem area goal of AID, it will have to be achieved by an increased use of plant proteins. The grain legume crops are the most promising for this purpose and among the grain legumes soybeans rank highest.

Present production levels of soybeans in most countries of the tropics and subtropics rarely reach 400 kg/ha which is less than one-fourth of the 1,750 kg/ha average yield of the United States. Yet the experimental results already achieved in Indonesia, Nigeria and Ecuador (3,000 kg/ha) indicate it is at least possible to reach one-half of the U. S. highest expected yields (6,000 kg/ha) in a single crop. Yields in Puerto Rico when the crop has been grown on a year-round basis have considerably surpassed that limit. Thus, there can be little doubt that a high payoff can result from AID's support of an international soybean improvement program.

Recent developments in Brazil, Mexico, and particularly India, indicate a much greater potential for soybean productivity than had been thought possible.

C. Progress Report

Results of growing 15 varieties of soybeans in 27 tropical countries showed that the soybean plant has wide adaptation. By this means plant types can be selected which have the proper photoperiod and best resistance to diseases and insects. Out of these trials will come improved breeding material for use in the various country programs aimed at developing still further improved varieties.

Information from the variety trials and breeding programs is integrated into the USDA Taxanomic Information Retrieval Systems (TAXIR), Presently there are more than 3,700 entries in data bank.

A major regional conference of 80 scientists was held in Addis Ababa in October 1974 on soybean production, protection and utilization. (The proceedings were published in March 1975 as INTSOY Publication No. 6.)

Plans have been completed for an Asian conference of scientists to be held in Chiang Mai, Thailand in February, 1976. The Ford Foundation and AVRDC are cooperating in this conference.

Soybean entomology and pathology work was initiated in cooperation with the University of Puerto Rico. Through this research local scientists will be able to identify the major insects and diseases which can be expected, and generate basic information on pathogens to predict their spread.

A one-year grant of $100,000 by the Rockefeller Foundation permitted work to get under way at Mayaguez, Puerto Rico on soybean storage problems, and also helped to strengthen the work in plant protection.

The INTSOY Newsletter is issued quarterly to 1,000 subscribers and serves as a linkage to research in the tropics and subtropics. For further details see the Annual Report of Contract TA-c-73-19 for the period April 1, 1974 to March 31, 1975.

D. Significance to AID Objectives

Soybeans offer a greater potential for lessening the LDC protein and calorie shortage than any other grain legume.

With the high cost of nitrogen fertilizer, soybeans appear more attractive than heretofore for developing countries where they can be grown. For other countries it would appear likely that adapted varieties can be developed.

E. Outline of Work Objectives

1. Develop technical assistance and research programs in tropical soybean variety improvement, cultural practices, inoculation, pest control, and harvesting, handling, and storage methods.

2. Screen and breed the soybean for broad adaptation to tropical soils, climates, and insect and disease resistance.

3. Conduct research on *Rhizobium japonicum* strains under conditions of high soil temperatures and submerged soils directed at solving problems associated with these conditions.

4. Conduct research on pest management systems with emphasis on low chemical and biological means of control.

5. Conduct research on seed-borne microorganisms and pathogens associated with soybeans, the pathogenicity of the variously isolated organisms and their role in reducing germination and emergence of soybean seedlings and on the nature of the virus-like whitefly-transmitted pathogen causing yellow-stunt mosaic diseases of soybeans, and of other viruses affecting soybeans.

6. Conduct research on soybean seed storage moisture requirements to maintain viability in storage (on fungal and microbial contaminants plus moisture levels which cause this increase) on the use of various containers to protect against change in moisture content of soybean seed stored by small farmers or in village storage areas, and on the need for changing moisture content of stored soybean seed to minimize damage in handling and planting operations.

7. Improve and expand information system activities to provide to soybean workers accurate and timely information, data and material relevant to soybean production, protection, and use in tropical LDCs.

8. Assist in backstopping LDC institutions in conducting cooperative adaptive research in soybean improvement.

9. Provide improved varieties and information on production, protection, and utilization of soybeans to LDCs and cooperating research institutions for trial under the individual conditions of the developing countries.

III. Relation to Other Research

The University of Illinois, as a result of its previous contracts, has already established strong cooperative linkages with the Mississippi State University, CIAT, IITA, ICRISAT, AVRDC, other international research institutes, universities, and national organizations in LDCs.

The close ties maintained by the university with cooperators in LDCs and the international research institutes facilitate the delivery of the results of research, including new varieties of soybeans, to the research workers in the LDCs. Frequent visits by INTSOY scientists to developing countries provide opportunity for seminars or lectures to LDC research workers. At the same time, the visitors learn of problems inhibiting production, hindering plant protection efforts or delaying utilization of soybeans.

The soybean offers unique promise as a source of both protein and fats for human nutrition. Its high protein content (36-40 percent) and the excellent amino acid balance of the protein give it great potential nutritive advantage over other oilseeds and vegetable legumes. For example, the peanut has about 25 percent protein, and the protein content of most dry beans and edible legumes ranges from 22 to 28 percent. The oil content of the soybean (18 to 22 percent) gives it a potentially unique dual-purpose role in human nutrition, animal feeding, and industrial utilization.

IV. Proposed Plan of Work

A. Outline of Work Plan

The complimentarity of activities and the interdisciplinary approach to the attaining of project objectives suggests that work be performed in functional groups with the major groups being production, protection, and uses. Each group is discussed separately, keeping in mind that the groups will interact in the pursuance of contract objectives.

1. Production Group Activities

a. Conduct International Soybean Varietal Experiment (ISVEX) program in over 90 countries and 250 LDC locations.

b. In Puerto Rico increase seed from previous ISVEX trials and other locations for use in future varietal experiments.

c. Publish results of ISVEX trials annually.

d. Incorporate selections showing promise for tropical and subtropical environments in the crossing program at Illinois and Puerto Rico in cooperation with 211(d) activities.

e. Continue evaluation study, already in progress, of the effects of temperature and natural radiation on soybeans grown at different altitudes at the same latitude. Ecuador is the site of this experiment.

f. With the cooperation of economists in selected tropical areas, study the resources, cropping systems, costs and returns and operational constraints of small farmers in tropical LDCs.

g. Determine economically optimal fertilizer practices, weed control techniques and water use for soybeans on small farms in tropical LDCs.

h. Study cropping systems and cost/return analyses for small farms in the tropical LDCs.

i. Study storage and transportation systems for inoculant to identify optimum conditions for transfer of the soybean inoculant *Rhizobium japonicum* from point of production and storage to the farmer in LDCs.

j. Study the different strains of *Rhizobium japonicum* with existing varieties of soybeans in the tropics.

k. Determine the minimum numbers of *Rhizobium japonicum* needed to produce acceptable tap root nodulation.

l. Conduct selective physiological and serological studies of *Rhizobium japonicum* in the tropics.

2. Protection Group Activities

a. Screen soybean lines for disease resistance or tolerance in cooperation with the complimentary 211(d) breeding activity.

b. Study the nature of the virus-like whitefly-transmitted pathogen causing yellow-stunt mosaic.

c. Determine the pathenogenicity of the various organisms isolated and their role in reducing germination and emergence of soybean seedlings.

d. Conduct a study of the sites of primary infection by the various pathogens in the soybean seed.

e. Conduct research on soybean rust in cooperation with the Asian Vegetable Research and Development Center (AVRDC) and other research organizations.

f. Participate in assembling world literature on soybean virus and other diseases to facilitate dissemination of printed information to soybean scientists.

g. Conduct biosystematical research on lepidopterous pests of soybeans.

h. Develop a series of identification guides for insects associated with predators including pests, vectors parisitoids and predators.

i. Continue studies already in progress to determine relationships between the spread of insect transmitted viruses and vector behavior in soybean growing areas.

j. Conduct intensive collection activity in several ecological zones preparatory to applying pest management guidelines on an intensive basis.

k. In collaboration with Puerto Rican and LDC scientists, determine insect damage to soybeans under field conditions in Puerto Rico and selected LDCs.

l. Assemble and conduct bioassay of lines resistant to insect defoliators.

3. Uses Group Activities

a. Conduct a study of technical and economic aspects of soybeans in cropping systems of small farmers of the tropics and subtropics.

b. Establish linkages with marketing institutions and specialists in selected LDCs of the tropics and design and pretest a study of soybean marketing systems in those countries.

c. Initiate a study to determine the characteristics of protein food demand and the potential demand for soybased foods.

d. Maintain and expand tropical soybean germ plasm data bank for use of breeders, especially in tropical LDCs.

e. Compile literature related to production, protection, and use of soybeans in tropical environments.

f. Maintain and expand the reference collection of soybean pests to serve the needs of soybean workers of tropical LDCs.

g. Continue research on soybean seed moisture requirements to maintain viability under small farm storage conditions in consultation with Kansas State University and Mississippi State University.

h. Conduct studies on various containers that may be used by small farmers or village storage operators to protect against change of moisture content of stored soybean seed. (Collaboration with Mississippi State University and Kansas State University).

i. Plan, conduct, and evaluate on-campus and on-site training programs to backstop LDC institutions' programs of adaptive research in soybean improvement and strengthen institutional and individual linkages in the international soybean network.

B. Plan of Work by Objective

Work under the project will feature the interdisciplinary, interinstitutional approach used successfully in previous contracts and throughout the INTSOY program. In cooperation with the 211(d) activities, the project will sustain and improve INTSOY research competence in selected areas and improve communications with appropriate institutions in the U. S. and abroad. Specific goal-oriented activities will be undertaken for each objective in accordance with the following:

Objective 1. Developing of technical assistance and research linkages in tropical soybean variety improvement, cultural practices, inoculation, pest control and harvesting, handling, and storage methods.

UIUC has begun to build a worldwide network of linkages with institutions and individuals in tropical LDCs interested in developing soybeans as a crop for the nutrition of their populations. Expansion and strengthening of this network is a key element in the success of the contract program.

The primary thrusts will be through the INTSOY Variety Experiment Program and the Breeding Line Evaluation Program. Scientists in over 75 countries have participated in the Variety Experiment Program and new requests for participation are received regularly. The results

of varietal performance experiments are shared with all cooperators and are printed in the INTSOY Publications Series. This program will continue to provide basic data from which decisions on the development of breeding lines will be made.

By Year Two of the research contract, enough seed of promising varieties will have been incorporated into the complementary breeding program in Puerto Rico to expand evaluation trials to several locations. Scientists who cooperated in the varietal experiments will cooperate in the preliminary evaluation program. They will feed back reports on yield, plant height, photoinsensitivity, shattering resistance, pod height, insect and disease resistance and food acceptability. The network of institutions and scientists will be linked through INTSOY publications, site visits and workshops.

Objective 2. Research to screen and breed the soybean for broad adaptation to tropical soils, climate and insect and disease resistance.

The Variety Experiment Program has provided and will continue to provide a base for further research to screen the soybean for broad adaptation to tropical conditions. The temperate zone experiments, initiated in 1974/75, provide similar information for LDCs of the temperate latitudes. The results of these experiments are highly significant, both in terms of their value to the breeding program and in terms of production potentials for specific locations.

The varietal trials provide such useful information as: an evaluation of existing germ plasm in various environments; the potential for soybean production in an area; whether introduced varieties can be grown *per se* or whether an indigenous plant breeding program will have to be developed; genetic material that is desirable for a single trait, or for multiple traits, and which should be used in the breeding program.

Seed selections showing promise and characteristics for various LDC environments will be incorporated into the supportive crossing program in Puerto Rico. This program is concentrating on the development of breeding lines, which will be evaluated at various locations under the Breeding Line Evaluation Program. Selected breeding lines will be released to LDCs to facilitate national breeding programs.

It is not an objective of the INTSOY breeding program to develop a group of soybean varieties labeled INTSOY I, II, etc. The generation of broadly adaptable breeding lines with multiple favorable characteristics are parent material in national breeding programs in LDCs is the INTSOY goal. INTSOY believes that superior varieties produced in LDCs from breeding lines developed in the INTSOY program should have indigenous names.

Objective 3. Research on Rhizobium japonicum strains under conditions of high soil temperatures and submerged soils directed at solving problems associated with these conditions.

Nitrogen fixation has been identified by scientists as a key area in the production of legumes. Recent increases in the cost of energy and fertilizers, especially nitrogenous fertilizers, encourage an even greater emphasis on research and development in the area of legumes and nitrogen fixation.

Rhizobium japonicum is the effective rhizobium bacteria for soybeans. It establishes a symbiotic relationship with the plant whereby the rhizobium is able to fix or enzymatically reduce atmospheric nitrogen which is used by the plant. The symbiotic relationship is established in the nodules of the plant. The plant provides the rhizobia with carbohydrates, minerals and other essential growth substances.

Experience gained in the International Soybean Variety Experiment (ISVEX) program clearly indicates the necessity of inoculating soybeans when they are grown for the first time in LDCs. There are a number of soybean plant/Rhizobium japonicum situations under tropical conditions that do not exist in temperate climates.

The work on Rhizobium japonicum under this contract will focus on four major problem areas:

a. Study of storage and transportation systems to identify optimum conditions for transfer of Rhizobium japonicum from point of production or storage to farmers in LDCs. Experience in the ISVEX program shows that commercial strains of Rhizobium japonicum often lose viability if they are subjected to conditions of high temperature, long storage time and/or excessive transit time from the production/storage point to the field. Studies will be conducted on optimal types of inoculation for tropical environments, e.g., frozen or liquid concentrates, pelleted materials, other forms and on storage systems in LDCs, particularly at the terminal, distribution and farmer level. Methods of packaging Rhizobium japonicum for maximum protection during shipment over long, medium, and short distances will also be investigated.

b. Study the existing strains of Rhizobium japonicum with existing varieties of soybeans in the tropics. Current research indicates there is a definite strain x variety interaction which influences nodulation and nitrogen fixation. In cooperation with the 211(d) plant breeder consideration will be given to those aspects of plant genetics influencing nodulation

and nitrogen fixation. The feasibility of incorporating high nitrogenase activity of one soybean variety (Harosoy) into varieties adapted to the tropics will be studied.

c. Research on the minimum numbers of Rhizobium japonicum needed to produce acceptable top root nodulation and seed yield in the tropics. Research in the United States indicates that several hundred thousand Rhizobium japonicum are required for good tap root nodulation of soybeans under field conditions. Comparable data need to be generated for tropical environments, and trials designed for that purpose will be initiated in selected tropical LDCs.

d. Conduct selected physiological and serological studies on Rhizobium japonicum in the tropics. Physiological studies will be made on the length of survival of Rhizobium japonicum in submerged soils, the influence of monsoon rains and subsequent anaerobic conditions on the survival of Rhizobium japonicum, the influence of multiple cropping in the tropics on the survival of Rhizobium japonicum, the compatibility of different strains of Rhizobium japonicum under tropical conditions and its compatibility with other tropical microorganisms. Serological studies will include determining competitiveness of different strains of Rhizobium japonicum with new isolations for the tropics and determining the ecological niche established by Rhizobium japonicum in the tropical cropping system.

Objective 4. Research on insect pest management systems with emphasis on low chemical and biological means of control.

Special attention will be given to the control of major soybean insects. This will include biological and genetic control methods as well as low chemical control methods. Close cooperation with plant breeders and engineers is necessary and considerable field work will be conducted in Puerto Rico and other selected sites. Damage thresholds will be studied for insect pests and vectors, with the objective of minimizing insecticide requirements through the development/adaptation of pest management systems and programs.

Work has been initiated in Puerto Rico to adapt the Illinois Pest Management Guidelines to apply to conditions there. This is the first step in the eventual adaptation of the Guidelines for Tropical LDCs. As results warrant, sites in various ecological zones will be selected for intensive collection activity preparatory to applying the modified guidelines on intensive investigations from which pest management models can be developed for different ecological areas.

Objective 5. Research on seed-borne microorganisms and pathogens associated with soybeans, the pathogenicity of the various isolated organisms and their role in reducing germination and emergence of soybean seedlings and on the nature of the virus-like whitefly pathogen causing yellow-stunt mosaic diseases of soybean and of other viruses affecting soybeans.

Work on seed-borne and fungal diseases affecting soybeans will take the following steps: (1) identify the limiting soybean diseases in the tropics and subtropics; (2) generate for soybean pathogens basic information that can be used to predict their spread and importance; (3) devise methods to control or reduce the impact of diseases; and (4) assist in breeding tropically adapted soybean cultivars with resistance to important pathogens.

Early results with soybean diseases in tropical LDCs indicate several areas that require additional research; among which are (1) identification of important soybean viruses; (2) spread of seed-borne viruses; (3) role of seed-borne nicroorganisms in seed deterioration and death; (4) interaction of soybean cyst nematode and the charcoal rot fungus on soybeans; (5) soybean rust and its control; (6) general control of soybean diseases. Work to be done on soybean viruses will be closely coordinated with scientists in Puerto Rico.

Research on the nature of microorganisms involved in soybeans and the mechanism of seed or embryo death has been a concern of UIUC pathologists for many years. Results of previous studies indicate that a bacterium found in the soybean seed coat may contribute to poor stand establishment of soybeans in the tropics. Soybeans incubated in a moist chamber at various temperatures became covered with a bacterial growth. The isolates from affected seeds reacted identically as the ATCC isolate of *Bacillus subtilis* to seven biochemical tests. This was the first report of *B. subtilis* being seed borne on surface-sterilized soybean seeds.

The presence of *B. subtilis* on soybean seeds increased with increase in incubation temperatures from 24° to 50°C. Soybean seed germination declined with increased incubation temperature from 20° to 35°C. All seeds with *B. subtilis* died and began to decay. The occurrence of *B. subtilis* on seeds increased with each increase in storage time and temperature.

When soybeans seeds contaminated with bacteria are planted in soils at 35°C, there is significant reduction in germination. Soybean seeds planted in soils with high temperature (about 35°C) in Nigeria, Ghana, and other tropical countries had greatly reduced germination. *B. subtilis* may be an important factor in this situation.

Another area of research to be given consideration is a cooperative study on soybean rust and its control. A joint study will be developed by INTSOY with Asian pathologists and U. S. institutions to study this disease. The project will seek inexpensive means to control soybean rust until cultivars resistant to the causal fungus can be developed. A newly released Indian variety, Ankur (UPSS-38) is said to contain resistance to soybean rust.

With respect to controlling plant diseases, methods will differ between viral and seed-borne diseases. Diseases caused by seed-borne fungi and bacteria can be controlled by applications of a biotoxic and antibiotic chemical. Results of studies at UIUC indicate that fungicides may be useful to control some seed-borne fungi. A similar approach will be investigated for the control of seed-borne bacteria such as B. subtilis. Where appropriate, changes in cultural practices may also be effective in reducing or avoiding disease occurrence.

Soybeans are historically a crop of the temperate regions and knowledge of soybean diseases is based primarily on experience in temperate latitudes. An important objective, therefore, is to identify diseases that occur in soybeans in the tropical LDCs. One first step, in close collaboration with scientists at the University of Puerto Rico, is the study of the nature of the virus-like whitefly-transmitted pathogen causing yellow-stunt mosaic (Rhynchosia mosaic) disease of soybeans.

To be continued are studies on viruses infecting experimental plantings in Puerto Rico, using host range and serology series. Methods have been developed involving the use of microbiological filters to clarify the homogenate of test leaves rather than the use of a high speed centrifuge. This development allows field samples to be analyzed without the need for an equipped laboratory and may be of importance for LDC scientists.

In addition, research will continue on screening soybean lines for disease resistance or tolerance in cooperation with the pest management and breeding specialists. Experiments will be conducted to measure the spread of insect transmitted viruses in relationship to vector movement.

World literature on soybean diseases will also be screened. Information on soybean viruses and other diseases will be compiled in such a way as to facilitate dissemination of citations and summaries of results to soybean scientists of the tropical LDCs.

Objective 6. Research on soybean seed moisture requirements to maintain viability in storage (on fungal and microbial contaminants plus moisture levels which cause this increase), on the use of various containers to protect against change in moisture content of soybean seed stored by small farmers or in village storage areas, and on the need for changing moisture content of stored soybean seed to minimize damage in handling and planting operations.

Conditioning soybeans for storage and maintaining quality of soybeans in storage for seed, food and other uses is a major problem in tropical and subtropical areas. Maintaining seed viability is a critical requirement for a successful production program. Sophisticated facilities necessary for controlled environment storage of soybean seed are not generally available in tropical LDCs. Alternate methods of seed storage and conditioning need to be developed.

Published work on the problems of seed storage and preparation for storage in tropical areas is limited. Preliminary work has gotten under way in cooperation with the University of Puerto Rico focusing on three central problems:

(1) Determining soybean seed moisture content requirements to maintain viability for a maximum short-term storage time of nine months without ambient temperature control.

(2) Evaluating various seed storage containers for protection against seed moisture content change during storage at the farm and village level.

(3) Investigating the necessity of raising the moisture content of stored soybean seed in order to prevent damage in handling and planting.

Storage studies in Puerto Rico and other locations will be conducted with seed varieties selected in consultation with the plant breeders. Seed lots will be shelf stored in containers appropriate for farm use, at ambient temperatures or with moderate protection from temperature extremes. Initial moisture content of stored seed lots will range from approximately 7 percent to 13 percent. Samples will be withdrawn for testing at intervals and seed quality tests will be made.

Conditioning methods for seed storage and methods of reconditioning prior to use will be studied. Drying methods to be investigated under tropical conditions include: (1) sealed container storage with silica gel mixed into the seed for post seal drying; (2) forced air drying using silica gel to control relative humidity; and (3) forced air drying with humidity control by addition of heat. Reconditioning tests will determine the rate at which dry soybean seed absorbs moisture from humid air and how much moisture must be added to dry (seven precent to ten percent storage moisture content) beans to prevent damage in handling and planting.

Objective 7. To improve and expand information system activities to provide accurate and timely information, data, and materials relevant to soybean production and use in tropical LDCs.

Essential to the development and expansion of the base of knowledge about soybean production, protection and use in tropical LDCs is the orderly and systematic collection, analysis and distribution of information, data and materials to soybean workers in all countries. Four information management and delivery systems play important roles in the INTSOY program: (1) the soybean germ plasm data bank; (2) soybean literature compilation, retrieval and delivery capacity; (3) the reference collections of soybean pests; and (4) the INTSOY publication series.

A computerized soybean germ plasm data bank using the Taxonomic Information Retrieval System (TAXIR) has been developed by the University of Illinois, primarily with University resources but with limited resources of the U. S. Agency for International Development and the Rockefeller Foundation. With the expansion of soybean breeding for tropical and subtropical environments and development of germ plasm for these conditions, there is an increased need to make these germ plasm characteristics a part of the system and provide for retrieval and delivery of germ plasm information to soybean breeders. The TAXIR system will be expanded to develop the tropical and subtropical aspects of the system and make the information available to soybean workers of the tropics and subtropics.

An effective and efficient soybean information system for tropical and subtropical areas is highly dependent upon having an up-to-date literature base for these areas. The UIUC has outstanding soybean literature collections for soybean production and use in temperate areas. To serve the needs of the soybean workers of the LDCs, these need to be supplemented by acquisition of the growing literature as research in tropical areas expands. A concurrent need is that of developing a retrieval and delivery system to supply the relevant literature needs for interested institutions and individuals in the LDCs. This work will build on the Soybean Insect Research Information Center (SIRIC) of the Illinois Natural History Survey, a storage and retrieval system for the world literature of arthropods associated with soybeans, the international aspects of which have been augmented under Contract AID-ta-c-73-19. The library collection will be integrated with the libraries of the UIUC, the Illinois Natural History Survey located on the UIUC campus, and the University of Puerto Rico, Mayaguez, whose orientation toward soybean protection and collections in the Spanish language serves the needs of the Caribbean area, Central and South America. The work will also be carefully planned and related to bibliographic identification, storage, and retrieval systems being developed at other institutions in the soybean network such as that on grain legumes (including soybeans) being done at the International Institute for Tropical Agriculture (IITA) with the support of the International Development Research Council (IDRC).

A reference collection of soybean pests will be developed providing an identification and information service for soybean workers of the tropics and subtropics. This will keep current and expand upon the International Reference Collection of Soybean Arthropods, collected articles and abstracts. These collections will be developed in association with the University of Puerto Rico, Mayaguez Campus, with an orientation toward the needs of Latin America.

The INTSOY publication series has been initiated through support of the UIUC, the Soybean Research Contract AID-ta-c-73-19 and General Technical Services funds. The interest in and demand for the first six publications in the INTSOY series has demonstrated the important place of the series in meeting the informational needs of soybean workers. Experience has also shown the need for augmented editing, production, and distribution services.

Development of the four categories of information management and delivery capabilities will provide an effective information delivery system on soybean production, protection, and uses for soybean workers.

Objective 8. Assistance in backstopping LDC institutions in conducting cooperative adaptive research in soybean improvement.

Linkages with the institutions and professional personnel of tropical LDCs. either directly or through regional or international organizations, are of prime importance. INTSOY has developed relationships with more than 95 countries through (1) the INTSOY Soybean Variety Experiment Program (ISVEX), which expanded significantly under Contract AID/CM/ta-c-73-19; (2) task orders and AID Basic Ordering Agreement; and (3) soybean projects supported by national and international organizations.

These linkages, and their expansion under the proposed new contract, are essential to soybean improvement activities. Visits by INTSOY personnel will focus on linked institutions and professional personnel in tropical LDCs to (1) improve INTSOY awareness of environmental problems affecting the production and protection of soybeans and of technological and social problems encountered in their marketing, processing and utilization as human food, (2) transfer information and advice on practices and techniques found to be successfully adapted in LDCs having similar environmental or structural conditions, and (3) offering on-site consultation, advice and training services under jointly planned cooperative research programs.

An important technique in backstopping and linking with LDC institutions is through the venue of specialized training. Two experimental nondegree short courses were planned and conducted at UIUC in the spring and summer of 1975 under AID Contract CSD-3179, a Basic Ordering Agreement for participant training at UIUC: (a) TC 120-6 "Technical and Economic Aspects of Soybean Production" and (b) TC 120-7 "Soybean Processing for Food Uses". These courses proved to be successful as general courses and will be repeated, with modifications, in future years; however, experience shows a need for more specialized course development and offering. Planning for modified and new courses will be undertaken as a mjaor activity. Direct participant training costs, e.g., tuition, maintenance, and direct training costs will continue to be funded from AID/CSD-3179 and similar sources.

On-site short courses on a national or regional basis will be planned and conducted in cooperation with international centers and national research and education organizations with which INTSOY has special relationships. Program resources will be used to determine the need for, plan, organize, conduct, and evaluate such nondegree short courses for soybean workers in the tropics and subtropics. Funds to support trainees will be sought from national and international organizations with training programs and resources.

Objective 9. To make improved varieties and information on production, protection and utilization of soybeans available to LDCs and cooperating research institutions for trial under the individual conditions of the developing countries.

The release of material and information to facilitate soybean development and utilization for the benefit of small farmers and the rural and urban poor, far from being the end product or "final output" is an ongoing feature of the program. Soybean seed showing promise for production in tropical LDCs has been, and is being, increased in Puerto Rico. Some will be incorporated in the supportive crossing program in cooperation with 211(d) activities of the Universities of Illinois and Puerto Rico. As breeding lines are developed they will be released to LDCs to facilitate national breeding programs. It will not be a central objective of INTSOY to develop labeled varieties for release. Instead, broadly adaptable breeding lines with multiple favorable characteristics will be made available, together with appropriate backstopping, to LDCs for use as parent material.

V. Budget

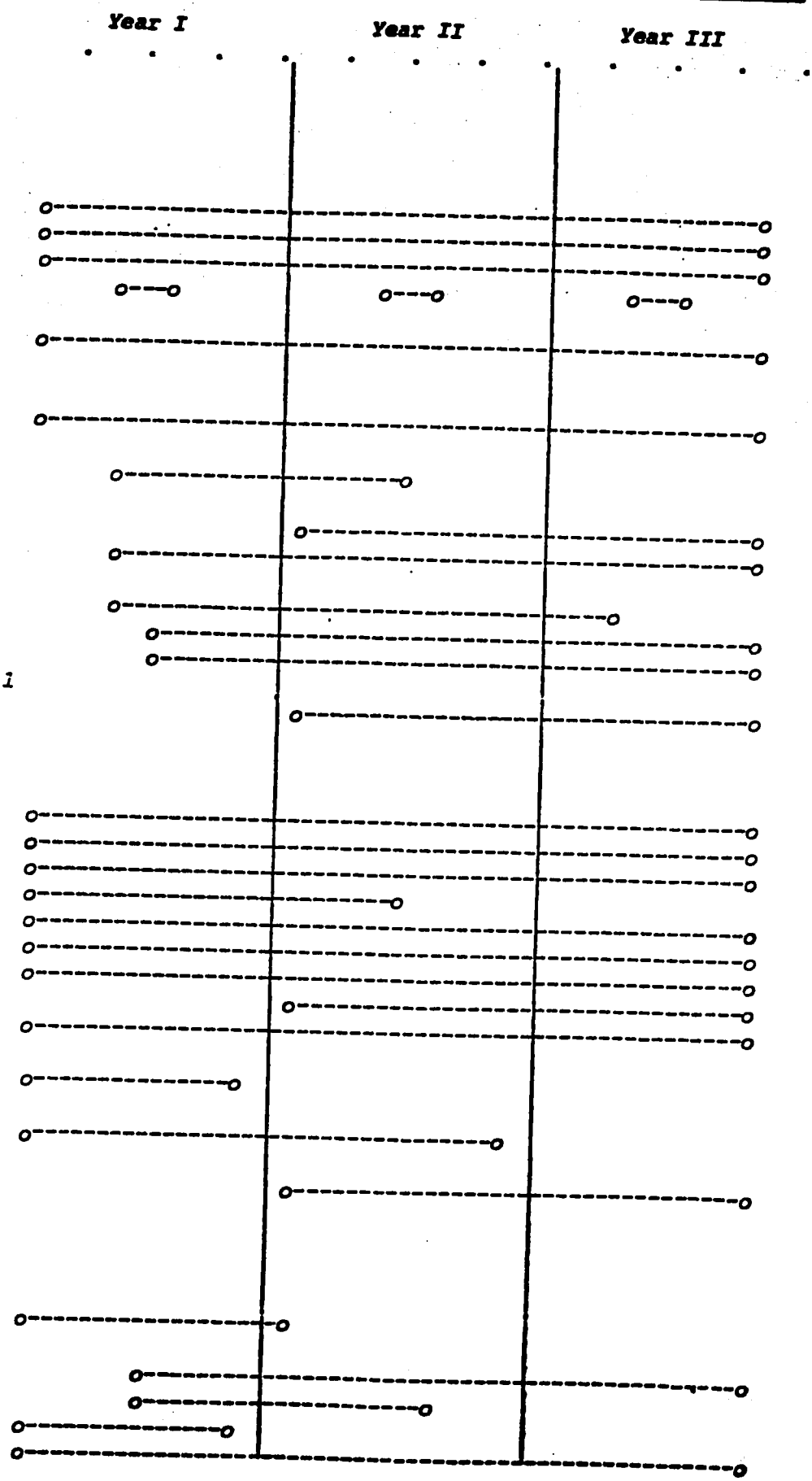
A life-of-contract budget with detailed annual expenditure and staffing pattern is attached as Appendix A. A line summary budget is presented below.

Proposed Budget

April 1, 1976 to March 31, 1979

I.	Salaries and Wages	$998,235
II.	Fringe Benefits	136,870
III.	Indirect Costs	658,835
IV.	Travel and Transportation	217,150
V.	Other Direct Costs	154,625
VI.	Equipment. Materials and Supplies	167,150
		$2,332,865

C. Project Schedule of Activities



Group/Activity

1. Production Group

   a. ISVEX program
   b. Increase seed UPMC
   c. Prelim evaluation trial
   d. Publish ISVEX results
   e. Crossing program with UPMC
   f. Temperature and radiation study resources
   g. Economic resources studies
   h. Economic practices studies
   i. Cropping systems
   j. Storage and transportation of *R. j.*
   k. Strains of *R. j.*
   l. Nodulation study
   m. Physiological/serological studies of *R. j.*

2. Protection Group

   a. Insect damage in field
   b. Bioassay defoliators
   c. Spread of viruses
   d. Collection of insects
   e. Lepidopterous pests
   f. Identification guide
   g. Screen for resistance
   h. Whitefly study
   i. Assemble literature
   j. Role of organisms in reducing germination
   k. Sites of primary infestation
   l. Cooperative rust research

3. Uses Group

   a. Technical and economic aspects of farming
   b. Linkage with marketing institutions
   c. Protein food demand
   d. Organize data system
   e. Germplasm data bank

Project Schedule of Activities (con't.)

	Year I	Year II	Year III
3. Uses Group con't			
f. Literature compilation	o----------	----------	----------o
g. Expanded reference collection	o----------	----------	----------o
h. Soybean seed resistance	o----------	----------o	
i. Study of storage containers	o----------	----------o	
j. On campus and on site training	o----------	----------	----------o

Proposed Budget
April 1, 1976 to March 31, 1979

	FTE	Year I	FTE	Year II	FTE	Year III	Total
I. SALARIES & WAGES		$314,045		$336,665		$347,525	$998,235
A. Professional Staff		(205,845)		(220,740)		(223,600)	(650,185)
1. Project Director	.25	7,550	.25	8,025	.25	8,585	
2. Assistant	.25	5,500	.25	5,885	.25	6,295	
3. Production Agronomist	1.0	18,000	1.0	19,260	1.0	20,610	
4. Plant Breeder	.75	13,500	.75	14,445	.75	15,455	
5. Agronomist/Breeder	.5	12,750	.5	13,650	.5	8,300	
6. Soil Microbiologist	1.0	24,000	1.0	25,680	1.0	27,475	
7. Assistant Agronomist	1.0	10,000	1.0	10.700	1.0	11.450	
8. Pest Management	1.0	17,000	1.0	18,190	1.0	19,460	
9. Soy Faunal Analyst	1.0	15,800	1.0	16,900	1.0	18,100	
10. Plant Pathology-Fungal	.25	7,330	.25	7,845	.25	8,395	
11. Plant Pathology-Virology	.75	12,415	.75	13,285	.75	14,215	
12. Plant Pathologist	.25	6,000	.5	12,850	.5	13,750	
13. Communications-Training Specialist	1.0	18,000	1.0	19,250	1.0	20,600	
14. Ag. Economist-Prod./Mktg.	1.0	25,000	.75	20,865	.5	16,030	
15. Seed Storage and Mech.	.5	13,000		13,910		14,880	
B. Support Staff		(108,200)		(115,925)		(123,925)	(348,050)
1. Research Asst.-Germplasm	.5	4,400	.5	4,710	.5	5,040	
2. Res. Asst.-Fungal Path.	.5	4,400	.5	4,710	.5	5,040	
3. Res. Asst.-Virus Path.	.5	4,400	.5	4,710	.5	5,040	
4. Res. Asst.-Pest Mgt.	.5	4,400	.5	4,710	.5	5,040	
5. Res. Asst.-Insect Inf. Ret.	.5	4,400	.5	4,710	.5	5,040	
6. Res. Asst.-Mkt. Econ.	.5	4,400	.5	4,710	.5	5,040	
7. Res. Asst.-Prod. Econ.	.5	4,400	.5	4,710	.5	5,040	
8. Technician-Seed Storage	.5	6,000	.5	6,420	.5	6,870	
9. Technician-Pest Mgt.	1.0	9,000	1.0	9,810	1.0	10,500	
10. Technician-Data Bank	1.0	10,400	1.0	11,125	1.0	11,900	
11. Library technical assistant	1.0	7,000	1.0	7,500	1.0	8,025	
12. Secy./Clerical	4.0	30,000	4.0	32,100	4.0	34,350	
13. Hourly Wages		15,000		16,000		17,000	

	Year I	Year II	Year III	Total
II. FRINGE BENEFITS	$ 43,115	$ 46,240	$ 47,515	$136,870
A. Retirement 11.38*	30,525	32,740	33,600	
B. Workmen's Comp. .20%	630	675	695	
C. HMS Insurance 4.0%	11,960	12,825	13,220	
III. INDIRECT COSTS 66%	207,270	222,200	229,365	658,835
IV. TRAVEL AND TRANSPORTATION	72,500	70,350	74,300	217,150
A. U.S. Travel	12,500	13,350	14,300	
1. Washington and Other	4,500	4,800	5,150	
2. Puerto Rico	8,000	8,550	9,150	
B. International	40,000	38,000	40,000	
C. Per Diem	20,000	19,000	20,000	
V. OTHER DIRECT COSTS	48,500	52,650	53,475	154,625
A. Computer	6,000	6,400	6,850	
B. Telecom and Office Exp.	5,000	5,350	5,725	
C. Publications	17,500	19,500	18,000	
D. Operations Support in P.R.	20,000	21,400	22,900	
VI. EQUIPMENT, MATERIALS & SUPPLIES	53,000	55,700	58,450	167,150
A. Seed and Freight	10,000	10,700	11,450	
B. Seed Analyses	3,000	3,000	3,000	
C. Supplies	30,000	32,000	34,000	
D. Equipment	10,000	10,000	10,000	
TOTALS	$738,430	$783,805	$810,630	$2,332,865

*1-B--1 through 7 and 13 not eligible for retirement benefits.