

AGENCY FOR INTERNATIONAL DEVELOPMENT PROJECT AUTHORIZATION AND REQUEST FOR ALLOTMENT OF FUNDS PART I		1. TRANSACTION CODE <input type="checkbox"/> A ADD <input type="checkbox"/> C CHANGE <input type="checkbox"/> D DELETE	PAF 2. DOCUMENT CODE 5
3. COUNTRY/ENTITY DS/AGR RDA-2 Type A. Research		4. DOCUMENT REVISION NUMBER 3 5	
5. PROJECT NUMBER (7 digits) [931-0560.11]	6. BUREAU/OFFICE A. SYMBOL B. CODE DSB [10]	7. PROJECT TITLE (Maximum 40 characters) [Improved Varieties of Soybeans]	
8. PROJECT APPROVAL DECISION ACTION TAKEN <input type="checkbox"/> A APPROVED <input type="checkbox"/> D DISAPPROVED <input type="checkbox"/> OK UNAUTHORIZED		9. EST. PERIOD OF IMPLEMENTATION (For 7½ month extension) YRS. [00] QTRS [3]	

10. APPROVED BUDGET AID APPROPRIATED FUNDS (\$000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE		E. Thru 9/30/78		H. 1st FY 79		K. 2nd FY 80	
		C. GRANT	D. LOAN	F. GRANT	G. LOAN	I. GRANT	J. LOAN	L. GRANT	M. LOAN
(1) FN	1111	975	-	3,066	-	520	-	-	-
(2)									
(3)									
(4)									
TOTALS				3,066	-	520	-	0	-

A. APPROPRIATION	N. 3rd FY 81		O. 4th FY 82		LIFE OF PROJECT		1. PROJECT FUNDING AUTHORIZED		A. GRAN - 2. LOAN	
	C. GRANT	D. LOAN	R. GRANT	S. LOAN	T. GRANT	U. LOAN	ENTER APPROPRIATE CODE(S): 1 - LIFE OF PROJECT 2 - INCREMENTAL LIFE OF PROJECT			
(1) FN	0	-	0	-	3,586	-			2	-
(2)										
(3)										
(4)										
TOTALS		0	-	0	-	3,586	-	C. PROJECT FUNDING AUTHORIZED THRU		FY [79]

12. INITIAL PROJECT FUNDING ALLOTMENT REQUESTED (\$000)		13. FUNDS RESERVED FOR ALLOTMENT	
A. APPROPRIATION	B. ALLOTMENT REQUEST NO. _____		TYPED NAME (C/N/I, S/R, F/M/FSD)
	C. GRANT	D. LOAN	
(1)			SIGNATURE
(2)			
(3)			DATE
(4)			
TOTALS			

14. SOURCE/ORIGIN OF GOODS AND SERVICES

000
 341
 LOCAL
 OTHER _____

15. FOR AMENDMENTS, NATURE OF CHANGE PROPOSED

Seven and one-half month administrative extension (April 15, 1979 to November 30, 1979) requiring additional funds of \$520,000 for subject project. This amendment is required to provide the time necessary to conduct an indepth review on June 18-22, 1979 and to complete the documentation and contracting for a three-year project extension recommended by RAC at their January 29-30, 1979 meeting.

FOR RAC/RIAS USE ONLY	16. AUTHORIZING OFFICE SYMBOL	17. ACTION DATE	18. ACTION REFERENCE (Optional)	ACTION REFERENCE DATE
		MM CC YY		MM CC YY

PROJECT AUTHORIZATION AND REQUEST FOR ALLOTMENT OF FUNDS

PART II

ENTITY : Bureau for Development Support

PROJECT : Development of Improved Varieties of Soybeans
Supporting Cultural and Marketing Practices for
Production in the Tropics and Information
Delivery Systems

PROJECT No. : 931-0560.11

I hereby authorize \$520,000 in grant funds for a seven and one-half month extension (from April 15, 1979 to November 30, 1979) of the subject project with the University of Illinois. The total approved funding level for this project is hereby increased from \$3,066,000 to \$3,586,000. This extension of the project will provide the time required for conducting an indepth review on June 18-22, 1979 and to complete the documentation and contracting for a three-year project extension recommended by RAC at their January 29-30, 1979 meeting.



Tony Babb
Deputy Assistant Administrator
for Food and Nutrition
Bureau for Development Support

4/23/79

Attachment

DS/AGR Memo to DAA/FN/DSB
dtd 3/27/79

Clearances:

DS/AGR/FCP:JMYohe JMY Date: 4/3/79
DS/AGR/FCP:KMBergo KMB Date: 4/3/79
DS/AGR:MMozynski MM Date: 4/3/79
DS/AGR:DFPeterson DF Date: 4/3/79
DS/PO/RES:MRchcigl MR Date: 4/11/79
DS/PO:RSimpson RS Date: 4/11/79

UNITED STATES GOVERNMENT

Memorandum

TO : DAA/DS/FN, Tony Babb

A C T I O N
DATE: March 27, 1979

FROM : DS/AGR, Dean F. Paterson *Dean F. Paterson*

SUBJECT: Seven and one-half Month Administrative Extension Requiring \$520,000 for the Research Project "Development of Improved Varieties of Soybeans Supporting Cultural and Marketing Practices for Production in the Tropics and Information Delivery Systems", (Project 931-0560), (Contract AID/ta/c-1294)

Problem. Your approval is required for a seven and one-half month \$520,000 administrative extension to provide the time necessary to carry out the documentation and contracting for this three-year project extension which was recommended by RAC at their January 29-30, 1979 meeting.

Discussion. A.I.D. initiated this research project with the University of Illinois in 1973 to support research in soybean breeding, agronomy, pathology, entomology, and soybean foods. A.I.D. has obligated and funded a total of \$3,066,000 since 1973 for this project.

Soybeans offer a greater potential for lessening the LDC protein and calorie shortage than any other grain legume. Soybeans, averaging about 40 per cent with excellent nutritional balance and capable of producing high yields, are the most promising potential source of vegetable protein and also produce large quantities of useful edible fats. Experience in the International Soybean Variety Experiment (ISVEX) indicates that the soybean is a far more widely adaptable legume than was previously thought; satisfactory yields can be obtained over a wide range of agroclimatic conditions following good management and cultural practices.

Recent evidence demonstrates that soybean cultivation is practical under small farm conditions in tropical and subtropical areas, including many regions where protein shortage presently is acute. To accelerate the rate of expansion, more information is needed on the cultural requirements of the crop in the subtropical and tropical latitudes and on varieties that are needed which are better adapted to short day-lengths and high temperatures. There is continued need to search for varieties exhibiting superior cooking qualities. Work in disease, insect, and weed control through collaborative activities of viral and fungal plant pathologists, entomologists, and weed scientists will continue to focus on an improved knowledge base and management systems for tropical and subtropical environments. Work in progress to develop improved production, harvesting, handling, and storage methods for seed and grain under tropical conditions will continue.



Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

The DSB Review Committee and RAC both have reviewed the project paper which was a request for approval of a three-year extension. Both committees recommended the project for a three-year extension.

The present contract on this project will terminate on March 31, 1979. DS/AGR has processed a fifteen-day extension at no cost for the period April 1, 1979 to April 15, 1979. The in-depth evaluation scheduled for October 16, 1978 had to be postponed due to A.I.D.'s restriction on travel at that time. The review is now scheduled for June 18-22, 1979. By extending the present contract for 7.5 months, DS/AGR can conduct the review, report to RAC, and implement any revisions deemed necessary in the project paper before completing the contracting process for the full three-year extension. This will allow DS/AGR to exercise a greater degree of managerial control over the design and future implementation of the project.

The work to be performed with the additional \$520,000, 7.5 month extension will continue activities as specified in the "scope of work" of the currently approved project paper and also as specified in the existing current contract.

This continuation is based on an earlier unsolicited research and development proposal. This extension meets the guidelines for contract amendments, under exceptions to normal negotiation procedures, 41 CFR 7-3.101-50(c) (2) where contract amendments which provide for the "continuation of activities" or assistance, which in the judgement of the contracting officer are designed to meet a goal which is the same as, or substantially similar to, the goal stated in the original contract.

A Soybean Collaborative Research Support Program is scheduled for implementation in FY 82. All subsequent activities to the eventual extensions through March 31, 1982 of this project will fall within the purview of this upcoming Soybean Collaborative Research Support Program.

Pertinent to the RAC recommendations on reduced funding levels for the new project proposal, the University of Illinois has been informed of these recommendations and requested to present two levels of funding. One would be a minimum project below which it would be impractical to continue the project. A second level would indicate what in their opinion is a more optimal level considering international soybean research needs. A clear delineation would be made as to specific additional activities and their cost at the optimal level as compared to the minimal level.

The University of Illinois has been informed that at the July meeting there is an equal chance that RAC may recommend for project termination as for project extension. In the case of termination, the period from July through November would be used as a phase out period and in the case of extension the period would be used as a transition from the old to new project objectives and scope of work.

931-17-130-560 U
 9310500-5
 PD-AAC-821
 AID-ta-c-73-19 -RES

CONFIDENTIAL PROJECT

Major Type of Activity: Key Problem Area - Higher Protein Crop Production 2p

Project Title: Development of Improved Varieties of Soybeans and Supporting Cultural Practices for the Tropics

Contractor: Illinois University, 113 Mumford Hall, Urbana, Illinois 61801

Contract Number:

Contract Coordinator: Dr. Earl R. Leng
 Title: Assistant Director, International Agricultural Programs

Project Number:
 Present:

Project Duration: Started 9/1/71 Termination Date Eight years

Budget:		Illinois	Puerto Rico	Total
a)	Funds obligated through FY 70	-	-	-
b)	Funds for FY 71	-	-	-
c)	Funds for FY 72	125,000	75,000	200,000
d)	Funds for FY 73	125,000	100,000	225,000

TA/AGF Project Manager: Dr. C. A. Breitenbach
 TA/AGF Agronomy Research Project Specialist: Dr. S. C. Litzenberger

Purpose: Soybeans are rapidly becoming an important food legume crop in developing nations. Each day they are contributing more needed protein in the developing nations to more nearly balance the diets of people living where cereals and root and tubers are the major food crop grown. However, the rate of increase is much too slow to satisfy the ever increasing need for more protein. With the concentration of effort on the selection of soybean varieties especially bred to compete favorably for yield with other crops in the tropics even greater increase of this high protein crop can be expected to serve the needs of developing nations. Heretofore in the tropical environments soybeans have yielded only a fraction of their known capacity. Part of this is because the varieties used were selected for growing in the temperate environments where sunlight, rainfall, temperatures, prevalent diseases and insects are not the same as encountered in the tropics, the result being inferior production.

With the development of higher yielding soybeans varieties especially bred for the tropics it is expected that this high protein legume will become competitive with other food crops. Soybeans are presently the most extensively grown legume crop in the world. Only rye is less extensively grown of the cereals. With more protein needed in the tropics and soybeans being a warm-season crop they have been selected as one of the food legumes as having the greatest potential in the tropics.

Description of Activity: This project is designed to develop high yielding varieties of soybeans and supporting cultural practices for the tropics. Soybean breeding work will be conducted at Illinois and Puerto Rico in conjunction with cooperative work at CIAT in Colombia, IITA in Nigeria, and the major national research centers conducting soybean research such as Brazil, Colombia, India, Pakistan, Turkey, Iran Tanzania, Nigeria, Vietnam, Thailand, and Indonesia. The work in plant breeding will be linked to a uniform adaptability trial to satisfy different climate and soil conditions. Biochemical evaluations for protein and amino acid balance will be made only on the most advanced breeding materials in the Illinois laboratory. Other evaluations will not be discouraged, but the first priority must be given to the development of high yielding strains and improved cultural practices.

Accomplishments and Utilization: None as yet since the project is to just get started; however, there is reason to predict tremendous progress in the development of superior strains of soybeans and supporting techniques for their successful production in the tropics as Illinois is uniquely qualified in this area. As these varieties are being developed needed tropical soybean research and production trainers would be trained at Puerto Rico and Illinois. In turn these would help extend the favorable efforts of this activity.

Future Plans: To fully satisfy the objectives of this project will require at least eight years. Should one or more of the International Improvement Centers wish to assume regional or world-wide leadership roles in the improvement of soybeans, then the objectives of this project would be changed and appropriate action would follow.

TA/AGF:SCLitzenberger:cfe:6/23/71

2/19/74

INTSOY Project
Department of Agricultural Engineering.

Project Title: Soybean Seed Storage in Tropical and Subtropical Areas

3

Project Number:

Justification:

Conditioning soybeans for storage and maintaining quality of soybeans in storage for seed, food, and commercial uses are major problems in tropical and subtropical areas. Maintaining seed viability is a critical requirement for a successful production program.

The sophisticated facilities necessary for controlled environment storage of soybean seed are not commonly available in tropical and subtropical areas of the world. Production of soybeans to meet the nutritional needs of these areas requires that alternate methods of seed storage and conditioning be developed.

Previous Work:

Published work on the problems of seed storage in subtropical and tropical regions is limited. The references cited by Delouche, et al.¹ in 1973 appear to constitute the most comprehensive listing available. Most are research papers or contract reports from the Seed Technology Laboratory, Mississippi State University. None are specific in dealing with soybeans. Welch and Delouche² indicate the desirable environmental conditions for seed storage and suggest typical construction details and equipment. This level of technology is not generally available in tropical areas of the world.

The limitations imposed on the drying process (preparation for storage) when soybeans are intended for special use such as seed or food have also received only limited attention. Matthes, et al. describes several relatively unsophisticated drying systems developed in recent years and reports on the evaluation of an indicator strip to determine if seeds are dry enough for storage. References 4, 5 and 6 all report satisfactory drying of soybeans, with or without heat, if the relative humidity of the drying air is controlled between 40 to 50%. Walker⁴ reports satisfactory storage of soybean seed at temperatures of 15-30° C with a 12.1% moisture content.

Objectives:

1. To determine soybean seed storage moisture content requirements to maintain viability for a maximum short term storage time of nine months without ambient temperature control.
2. To evaluate various seed storage containers for protection against seed moisture content change during storage at the farm and village level.
3. To investigate the necessity of reconditioning (raising the moisture content) of soybean seed from storage in order to prevent damage in handling and planting.

4. To develop soybean seed drying techniques and equipment suitable for farm or village level use.

Procedure:

Storage studies will be conducted with seed varieties selected in consultation with the Department of Agronomy. Tests in Puerto Rico will be conducted under the direct supervision of Mr. E. J. Ravalo. Dr. E. D. Rodda will consult with Mr. Ravalo in the planning and execution of these tests and will conduct parallel laboratory tests in Urbana.

Seed lots will be stored in containers appropriate for farm use such as: (1) sealed metal cans, (2) metal cans with a plastic bag liner, (3) multi-layer paper bags with plastic linings, and (4) cloth bags. Containers will be shelf-stored at ambient temperature or with moderate protection from temperature extremes such as placing them in a second container insulated with rice hulls. Seed lots will be stored at a range of initial moisture contents from approximately 7% to 13%. Duplicate sealed metal can samples will be stored in Urbana at the approximate mean temperature of record for the Isabela and Lajas experiment stations.

Samples will be withdrawn for testing at intervals and seed quality tests will be conducted in cooperation with the Departments of Agronomy at Mayaguez and Urbana. Moisture content changes in storage will be checked by oven samples.

Conditioning methods for seed storage and methods of reconditioning prior to use will be studied during the sample storage periods. The drying methods to be investigated under tropical conditions are: (1) sealed container storage with silica gel mixed into the seed to do the drying after sealing of the container, (2) forced air drying using silica gel to control the 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 seed (7% to 10% storage moisture content) to prevent damage in handling and planting.

Probable Duration: Three years

Financial Support: International Soybean Program

Personnel: Project Leaders: Illinois-Errol D. Rodda
Puerto Rico-Eliodoro J. Ravalo

Project Members: Carl N. Hittle
W. Ralph Nave

Institutional Units Involved:

Department of Agricultural Engineering
Department of Agronomy
U.S. Department of Agriculture

List of References

1. Delouche, J. C., R. K. Matthes, G. M. Dougherty, and A. H. Boyd. 1973. Storage of seed in sub-tropical and tropical regions. *Seed Sci. & Technol.* 1:663-692.
2. Welch, G. B. and J. C. Delouche. 1968. Environmental and structural requirements for seed storage. Journal No. 1607, Mississippi Agricultural Experiment Station, State College, Mississippi. 14 p.
3. Matthes, R. K., J. C. Delouche, and G. B. Welch. 1969. Seed conditioning in tropical environments. Journal No. 1738, Mississippi Agricultural Experiment Station, State College, Mississippi. 23 p.
4. Walker, R. J. 1974. Drying soybeans for seed. Proc. Grain Conditioning Conference, Univ. of Illinois at Urbana-Champaign. pp. 10-17.
5. Rodda, E. D. 1974. Soybean drying for food. Proc. Grain Conditioning Conference, Univ. of Illinois at Urbana-Champaign. pp. 18-19.
6. Matthes, R. K. and G. B. Welch. 1974. Heated air drying of soybeans seed. Paper No. 74-3001, presented at the Annual Meeting of the American Society of Agricultural Engineers Stillwater Oklahoma 17 p.

Agricultural Experiment Station

University of Illinois

PROJECT OUTLINE

Project numberTitle

Soybean Diseases Caused by Viruses of Importance in the Tropics

Previous work

Legume viruses of importance in tropical areas have attracted the occasional attention of virologists for many years. Costa and his colleagues (Costa, 1955; Costa, 1965; Costa and Carvalho, 1960; Costa and Carvalho, 1961) and Silberschmidt (Flores and Silberschmidt, 1966) in Brazil, Bird and his colleagues (Bird, 1962; Bird and Sanchez, 1971; Bird et al., 1973; Bird et al., 1974a; Bird et al., 1974b) in Puerto Rico, and Nene and others (Nene, 1972 and references cited therein) in India, have recently published the results of studies on tropical legume viruses. These studies are generally confined to descriptions of symptoms and host ranges and the results of transmission tests. Rarely have their results been extended to the improvement of the crop plant affected or to changes that could be made in cultural practices that might mitigate the impact of the diseases. Few thorough going surveys of the occurrence of legume viruses in the tropics have been made, and no concerted attempt has been made until recently (in Puerto Rico) to study any virus disease of food legumes in a tropical setting combining diagnosis, assessment of importance, means of spread, characterization of the pathogen, virus-vector relationships, and the application of the results to improve crop yield.

Many legume viruses of tropical plants have been described, some more thoroughly than others. But little is known about which of these may spread to soybeans and of what importance they will be in the performance of this crop in tropical areas. Moreover, even less is known about the viruses indigenous to the tropics that may spread to soybeans (Bird, et al., 1974a).

Over 25 viruses are known that can infect soybeans (Thornberry, 1966; Tamada, 1970; Bos, 1964), but of these only a few are of any consequence in temperate areas (Dunleavy, 1973). All of the important soybean viruses infect other legumes and all but one are transmitted by insects (aphids, thrips, or beetles). The likelihood that spread of these viruses will occur from indigenous vegetation to soybeans is great. On the basis of experience in central and southern regions of the United States, the soybean diseases caused by these viruses will be more severe in the tropics than they are in temperate areas. In addition to the conventional, well-characterized viruses of soybeans, several soybean diseases caused by virus-like agents that are spread by whiteflies have recently been described (Bird et al., 1974a; Bird and Sanchez, 1972; Costa, 1955). One of these, an agent from

a common leguminous weed, Rhynchosia minima, causes a very severe disease of soybeans in Puerto Rico. The disease agent, probably a virus, is thought to be related to similar agents causing diseases of beans in India and Brazil (Capoor and Varma, 1948; Nene, 1972; Nene, 1973; Costa, 1965; Flores and Silberschmidt, 1966). In Puerto Rico the same agent causes important diseases of tobacco, okra, beans, and pigeon pea (Cajanus cajan). The whitefly-transmitted virus-like agents have not been fully characterized, and while they may be viruses, they may also represent a new or unusual class of plant pathogens. Few of this type of agent are of importance in temperate latitudes.

Justification

— That soybeans can be grown successfully in tropical areas has been clearly established. The world-wide need for the high quality protein and high quantity of oil that soybeans can provide is critical, and the need is greatest in tropical areas. But plans to begin soybean production in the tropics cannot be made with confidence of success unless much more is known about the diseases, particularly virus diseases, that may affect this crop in tropical settings. This is so especially in view of the many legumes and legume viruses that are present in agricultural areas of the tropics and in view of the abundance of insects that may be vectors of these viruses.

The research proposed in this outline will result in an improved knowledge of the likely virus disease problems that will arise as soybeans are introduced in a wide variety of tropical climates and cropping systems. The results of these studies will be useful to the cooperating pathologists in tropical countries, who will gain experience and insight into soybean diseases and soybean production in their area, to the general agricultural economy of the developing nations, which will benefit from thriftier crops and higher yields, to soybean breeders, who will have information on which to confidently base their search for disease resistant and tolerant genotypes, and to soybean entomologists, who through their cooperation in parts of this research will gain knowledge about the insects that are important vectors of viruses as well as those that may be pests in their own right. The results can also be expected to further our general knowledge of plant virology. Tropical plant virology is still very much in a descriptive phase and lags behind in the development of epidemiological and etiological studies. Elucidation of the nature of the whitefly-transmitted virus-like agents would be a particularly important advance in our understanding, since there are over 30 plant diseases, mainly of tropical plants of which the causal agent falls in this class of pathogens.

It is conceivable that some of the disease agents that affect soybeans in the American tropics could spread to soybean producing regions of the southern United States, where the climate is not unlike that in the subtropics. Thus, another benefit that will come from the research proposed here is an understanding of the potential threat these agents may pose to domestic soybean production.

The proposed research will fulfill the following overall objectives: to improve our understanding of the nature and means of spread of soybean

viruses in tropical areas, to encourage and stimulate the development of an interested and competent corp of plant pathologists to conduct research on soybean virus diseases in tropical regions, to assemble and disseminate knowledge about soybean virus diseases in the tropics, and to provide information and technical assistance to plant breeders in their attempts to test new soybean varieties for resistance or tolerance to important soybean diseases.

Objectives

1. To purify and characterize in detail the nature of the virus-like whitefly-transmitted agent causing yellow stunt mosaic (Rhynchosia mosaic) disease of soybeans in Puerto Rico.
2. To establish soybean disease trials in representative tropical areas that have a high potential for future soybean production from an agronomic and climatic point of view, and to carry out cooperative surveys of soybean viruses.
3. To devise procedures for efficient and thorough screening of soybean varieties for disease resistance or tolerance.
4. To devise sophisticated but simple methods enabling relatively untrained personnel to diagnose soybean virus diseases on location in tropical areas without requiring sophisticated or expensive equipment.
5. To assemble the world literature on soybean virus and other diseases in such a way as to make citations and summaries of results readily available for dissemination.

Procedure

1. The plant virology laboratory at the University of Puerto, Rio Piedras, under the direction of Dr. Julio Bird, is engaged in whitefly-transmission studies of the Rhynchosia mosaic agent and is also equipped to search for evidence of a virus-like particle by electron microscopy. Results of tests in Dr. Bird's laboratory show that the agent can be mechanically transmitted, but transmission was infrequent and erratic. In cooperation with Dr. Bird and his colleagues a new research effort will be made to obtain efficient mechanical transmission of this pathogen. Traditional methods will be used in initial attempts to transmit this agent, but new approaches will be used. Infected tissue will be chilled and homogenized at ice temperature in a variety of buffers at high and low pH. Bentonite and other anti-nuclease agents will be used. Phenol extraction will be used in attempts to obtain infectious nucleic acid. Freshly cut tissue will be used directly without homogenization. Attempts will be made to transmit from plant parts other than leaves, such as roots and flowers. The results of preliminary tests in Dr. Bird's laboratory give reason to be confident that simple means can be found to transmit this pathogen easily and regularly.

Concurrently, infected plants will be established in isolated, quarantined greenhouse or growth chamber space at the University of Illinois, where extraction and isolation methods will be developed to concentrate and purify the pathogen using ultracentrifugation, chemical fractionation, and electrophoresis. Depending upon the results of preliminary tests the research will emphasize chemical stabilization of the agent, if it proves to be labile, or concentration of the agent, if it proves to be stable but present at very low concentrations. Electron microscopic examination of preparations during this phase of the investigation will be done at both the University of Illinois Electron Microscopy Center and in the plant virus laboratory at Rio Piedras. If the pathogen proves to be of an unconventional nature other sophisticated biochemical or optical techniques will be developed to characterize it.

2. Cooperative agreements will be made with plant pathologists in several tropical countries where interest in and potential for soybean production is high. In some of these countries a disease trial will be planned in which about six promising soybean varieties will be planted in a suitable location not isolated from other crops grown locally. The varieties grown and the cultural practices followed will be suited to each country and will be based on experience gained in the INTSOY variety trial program. The trial will be large enough to give a good indication of the range and frequency of occurrence of the diseases encountered. Weekly observations of the development of the crop will be recorded by the cooperator in each location. Detailed observation of disease symptoms, patterns of spread, variety reactions, and, where an entomologist is also available, of insect occurrence, will be made. Plantings will be harvested and yields will be measured. Virus-infected plants will be tested serologically or by electron microscopy to help establish the virus responsible for all virus-like diseases encountered that are judged to be of potential importance. The rigor with which diagnoses will be made by each cooperator will depend upon the facilities available, the abilities of the cooperator, the the development of new diagnostic aids (see 4 below). The number of such trials will be kept small so that the project leader or the cooperating pathologist from the University of Illinois can visit each trial at least once during the growing season. New soybeans being developed for the tropics could receive early disease resistance evaluation in these trials once each cooperating pathologist has several seasons experience with soybean diseases. In other countries, especially those where large acreages are already planted, cooperative arrangements will be made to enable local plant virologists to thoroughly survey and identify the virus diseases present. Cooperative work done at Illinois would include final purification, antiserum production, and electron microscopy examination.
3. A program will be established to screen candidate varieties produced in the INTSOY breeding program for tolerance or resistance to virus diseases of importance in tropical areas. This is a somewhat longer range objective than others set out here, and the

methods and scope of these tests will depend on the diseases found to be important and the number of candidate varieties produced. Insect transmission tests under controlled conditions may be needed to determine the likelihood of virus spread by vectors such as whiteflies and aphids. Mechanical transmission tests will be needed for some viruses. Field trials can be incorporated into the disease trial program at appropriate locations.

An important long-range objective of the research proposed there is to stimulate plant pathologists in tropical countries to take an interest in soybean diseases so that as soybean development in their country progresses they will be in a position to contribute to it, and so that their knowledge about and ability to deal with soybean diseases will progress also. To this end, a need exists for simple diagnostic aids that can be used in the field or in laboratories lacking specialized equipment by people without specialized training. Ways of applying research results from this and other programs to diagnosis of soybean virus diseases will be sought. Where applicable, serological methods will be exploited. Cooperative studies with Dr. G. M. Milbrath, University of Illinois Plant Virologist, will be undertaken to learn how to prepare and to enhance the immunogenicity of the coat protein subunits of soybean viruses so that agar single or double diffusion or latex agglutination tests with suspect tissue and high titer anti-serum can be used for positive diagnosis. The exploitation of other approaches such as serologically-specific electron microscopy [Derrick, K. S. (1973). *Virology* 56, 652-655] will be explored; specimens could be collected in the field on antibody-coated grids prepared in the laboratory and observed when and where electron microscope facilities are available.

A collection of soybean disease citations has been started in connection with preparation of a Soybean Disease Compendium (M. C. Shurtleff and J. B. Sinclair, editors). Support and computer time will be sought to make this collection complete and to store citations and abstracts, cross referenced by author and subjects, for ready access. The assistance of soybean research workers around the world will be solicited to keep the information up-to-date. The literature bank envisaged will eventually be part of a larger system encompassing all aspects of soybean production and protection.

Duration

Five years, with revision at the end of this period

Personnel

Project leader
Cooperating personnel

Robert M. Goodman
J. B. Sinclair (University of Illinois)
J. R. Bird (University of Puerto Rico)
V. Garcia (University of Puerto Rico)
P. Melendez (University of Illinois)
G. M. Milbrath (University of Illinois)
Various plant pathologists in tropical countries

Institutional Units Involved

Department of Plant Pathology, University of Illinois
International Soybean Program, University of Illinois
Department of Agronomy, University of Illinois
Electron Microscopy Center, University of Illinois
Department of Plant Pathology and Botany, University of Puerto Rico
Department of Agronomy, University of Puerto Rico

Cooperation

Cooperative studies will be an important part of this project. Work will be done in cooperation with personnel at the University of Puerto Rico others at the University of Illinois, and also with a number of other international research centers and universities.

Literature

- Bird, J. (1962). A whitefly-transmitted mosaic of *Rhynchosia minima* and its relation to tobacco leaf curl and other virus diseases of plants in Puerto Rico. *Phytopathology* 52, 286 (Abstr.).
- Bird, J., and Sanchez, J. (1971). Whitefly-transmitted viruses in Puerto Rico. *J. Agr. Univ. Puerto Rico*, 55, 461-467.
- Bird, J., Peres, J. E., Alconero, R., Vakili, N. G., and Melendez, P. L. (1972). A whitefly-transmitted golden yellow mosaic virus of *Phaseolus lunatus* in Puerto Rico. *J. Agr. Univ. Puerto Rico*, 56, 64-74.
- Bird, J., Sanchez, J., Rodriguez, R. L., Cortes-Monllor, A., and Kaiser, W. (1974). A mosaic of beans (*Phaseolus vulgaris* L.) caused by a strain of common cucumber mosaic virus. *J. Agr. Univ. Puerto Rico*, 58, 151-161.
- Bird, J., Sanchez, J., and Rodriguez, R. L. (1974). Viruses affecting soybeans in Puerto Rico. *Proc. Workshop on Soybeans for Tropical and Subtropical Conditions*. INTSOY Publ. 2, 109-111.
- Bos, L. (1964). Tentative list of viruses reported from naturally infected leguminous plants. *Neth. J. Plant Path.*, 70, 161-174.
- Capoor, S. P., and Varma, P. M. (1948). Yellow mosaic of *Phaseolus lunatus* L. *Curr. Sci.* 17, 152-153.
- Costa, A. S. (1955). Studies on Abutilon mosaic in Brazil. *Phytopath.* 2, 24, 97-112.
- Costa, A. S. (1965). Three whitefly-transmitted virus diseases of beans in Sao Paulo, Brazil. *FAO Plant Protection Bull.* 15, 121-130.
- Costa, A. S., and Carvalho, A. M. B. (1960). Mechanical transmission and properties of Abutilon mosaic virus. *Phytopath.* 3, 37, 259-272.
- Costa, A. S., and Carvalho, A. M. B. (1961). Studies on Brazilian tobacco streak. *Phytopath.* 3, 42, 113-138.
- Flores, E., and Silberschmidt, K. (1966). Studies on a new virus disease of *Phaseolus longepedunculatus*. *Anais da Academia Brasileira de Ciencia* 38, 327-354.
- Dunleavy, J. M. (1973). Viral diseases. In "Soybeans: Improvement, Production, and Uses." (Caldwell, B. E., ed.). Amer. Soc. Agronomy, Madison, WI.
- Nene, Y. L. (1972). A Survey of the Viral Diseases of Pulse Crops in Uttar Pradesh. G. B. Pant University Press, Pantnagar, U.P., India.
- Nene, Y. L. (1973). Viral diseases of some warm weather pulse crops in India. *Plant Dis. Repr.* 57, 463-467.

Tanada, T. (1970). Aphid transmission and host range of soybean dwarf virus. *Ann. Phytopath. Soc. Japan* 36, 266-274.

Thornberry, H. H. (1966). Index of Plant Virus Diseases. USDA Agricultural Research Service, Agriculture Handbook No. 307.

1. Project Number-----50-345
2. Title-----Utilization of Whole Soybeans for Human Food in Developing Countries
3. Previous Work:

In January 1970 members of the Department of Food Science developed their first prototype products prepared from whole soybeans. (1) The preparation was readily accomplished with limited processing equipment. Although the work proceeded slowly due to lack of formal support the approach was unique. Relatively little work had been done previously on the processing of whole soybeans for human food.

Mustakas, et al, developed a process for the preparation of a dry soybean beverage. (2) This process was quite complicated as it required extrusion cooking and preparation of a full fat flour from raw soybeans which was followed by extensive dry-milling. The finely milled flour was then hydrated, flavored and finally spray-dried. The resulting product was acceptable but costly to prepare. New York State (Geneva) workers investigated the traditional Asiatic method for preparing soybean milk. They developed a modified method for preparation of soy milk which was known as the hot extraction process. (3,4) This method was superior to the traditional method. However, the product was characterized by some beany taste and the percentage of protein recovery was only fair -- about 40 - 60%.

The early products prepared at the University of Illinois contained the whole soybean, were very bland, and the preparation procedure was uncomplicated. Thus, the University of Illinois work appeared highly promising and encouraged further research efforts.

4. Justification.

There is a great need for the development of simplified processing concepts that can be used to prepare highly nutritious foods from whole soybeans. High protein, (nutritious) foods are needed in all countries. However, the need is most critical in the less developed countries. As we consider the future, the need for high protein, nutritious foods appears certain to increase rapidly. Thus, immediate effort is justified to complete development of the concept for processing whole soybeans for human food.

5. Objectives

1. To develop readily adaptable concepts for the preparation of various whole soybean food products for use in home and village industry in developing countries. Specific emphasis will be directed towards the preparation of simple soybean "milks" and other products such as high protein weaning and breakfast foods.
2. Nutritional evaluation of selected soybean products will be carried out. Protein efficiency ratios (PER) and amino acid analyses will be made on soybean food products which, on the basis of appearance and taste, show promise for human foods.
3. The effects of varietal differences of soybeans on rehydration and cooking quality will be studied. The specific objectives will be to find varieties that are most suitable for home cooking. Information of this type will be useful for plant breeders who are developing soybean varieties that are ideal for direct consumption as cooked beans.

6. Procedure

1. The concept or procedure used for the preparation and processing of whole soybeans at the University of Illinois will be used as a model for this work. Thus, the first step will be to inactivate the enzyme systems and the growth inhibitors with moist heat using simple or readily available equipment and techniques. This will be followed by simple milling or other treatments to prepare products such as soy "milks" or weaning foods. Eventually, if justified, work will be directed towards developing suitable processing equipment that can be used in small village industry.
2. Previous limited nutritional studies indicated that certain soybean products were superior to others in PER. Various soybean-cereal products exhibited substantial differences in nutritional value. Thus, detailed studies will be made to determine the effect of processing variables on PER. Studies will be conducted to determine the optimum soy-cereal combinations as well as the most desirable preparation and processing procedures. Evaluations will include acceptance tests as well as PER and amino acid determinations.
3. Work is under way in regard to the study of varietal differences on the direct cooking quality of soybeans. Initial studies suggest the possibility of differences amongst varieties as regards cooking time to optimal tenderness. A careful examination and evaluation of commercial varieties as well as certain exotic and vegetable strains of soybeans would be desirable.

Identification of varieties or strains of soybeans which require significantly less cooking time is of importance in developing varieties that require less energy expenditure to process for human consumption.

7. Duration

This work would certainly require a minimum of three years and perhaps as long as five years. Present USAID funding will terminate on April 1, 1975.

8. Personnel

L. K. Ferrier

A. I. Nelson

research associates or assistants

9. Institutional Units involved -- computer science
10. Cooperation -- Department of Agricultural Engineering and perhaps the Foods and Nutrition Division of the School of Human Resources and Family Studies.
11. Financial support
(See Attached Budget)

1. Nelson, A. I., L. S. Wei and M. P. Steinberg. Food Products from whole soybeans. Soybean Digest, January 1971.
2. Mustakas, G. C., Albrecht, W. J., Bookwalter, G. N., Sohns, V. E. and Griffin, E. L., Jr. New process for a low-cost, high protein beverage base. Food Technol. 25:80 (1971)
3. Hand, D. B., Steinkraus, K. H., Van Buren, J. P., Hackler, L. R., El Rawi, I. and Pallesen, H. R. Pilot plant studies on soy milk. Food Technol. 18:139 (1964).
4. Hackler, L. R., Van Buren, J. P., Steinbrause, A. H., El Rawi, I. and Hand, D. B. Effect of heat treatment on nutritive value of soy milk protein fed to weanling rats. J. Food Sci., 30:723 (1965).

INTSOY

Research Project

PROJECT NUMBER:

TITLE: Seed-borne bacterial and fungal pathogens of soybean and seed quality.

PREVIOUS WORK: There are over 55 bacterial and fungal pathogens of soybean. Many of the more important pathogens are seed-borne (1, 2, 8, 13, 15). Study on the seed-borne nature of the various pathogens of soybeans and their effects on seed quality has been neglected for many years. We have shown that *Pseudomonas glycinea*, causal agent of bacterial blight, which is seed-borne, occurs in seed lots collected from six states of the U.S. and in India (7, 10, 11, 15, 16). The bacterium can reduce seed germination in vitro and emergence in the greenhouse and field. The fungal pathogen, *Diaporthe phaseolorum* var. *sojae*, causal agent of pod and stem blight, also seed-borne, can kill seeds, reduce germination and emergence (3, 5, 6, 15). Three fungi have been shown to first colonize the hour-glass cell layer of the soybean seedcoat: *D. phaseolorum* var. *sojae*, *Colletotrichum truncatum*, causal agent of anthracnose, and *Cercospora kikuchii*, causal agent of purple stain, then spread to surrounding tissues (4, 12, 14). Planting date and storage conditions affect the occurrence of certain seed-borne microorganisms and, thus, influence seed quality (9).

JUSTIFICATION: In recent years Illinois, other soybean-producing states, and other countries, such as Ghana, Ethiopia, Nigeria, Puerto Rico, Egypt, etc. have had problems getting stands of soybeans in the field. This is due in part to poor quality seeds and seed-borne microorganisms. With the anticipated world-wide expansion of soybean and increased costs of production in the U.S., it is necessary that the role of seed-borne microorganisms in reducing germination and emergence be understood, then control methods may be developed.

OBJECTIVES:

1. Identify the various seed-borne microorganisms and pathogens associated with soybean seeds from a number of states and countries
2. Determine the pathogenicity of the various isolated organisms and their role in reducing germination and emergence of soybean seedlings;
3. Study the sites of primary infection by the various pathogens in the soybean seeds; and
4. Use the accumulated knowledge to develop reasonable control methods for these microorganisms.

PROCEDURE:

1. Collect soybean seed samples from various states and countries to determine the various microorganisms and pathogens internally seed-borne.
2. Using Koch's postulates, test for the pathogenicity of the isolated microorganisms on soybean seeds and seedlings, and their effects on in vitro germination and emergence.
3. Using histopathological techniques, locate the primary point of colonization within soybean seeds of various fungal and bacterial pathogens.
4. Using both nonchemical and chemical methods, determine methods for reducing the quantity and the level of primary inoculum in seeds.

The biological determination of microorganisms associated with soybean seeds from various locations within the U.S. and from other countries has begun. Surface-sterilized seeds are bioassayed on different media and at different incubation temperatures (20, 25, 30 and 35C) to recover most if not all the microorganisms found in soybean seeds. Koch's postulates have been completed on a few, but not all of the organisms now in pure culture. The area of primary colonization of three fungi in soybean seed has been completed. Work has begun on locating the bacteria in soybean seeds. Chemical control studies have been initiated.

The work is and will continue to be done in plant pathology laboratories located in the Horticulture Field Laboratory. There is a modern plant pathology laboratory available for these studies. However, additional incubators and a thermal-gradient plate system is required to further study interactions between temperature and expression of pathogenicity by seed-borne microorganisms.

DURATION: 3 years.

PERSONNEL:

James B. Sinclair; Project Leader
Prateung Sangawengse, Postdoctorate for 6 months ending February 1975.

INSTITUTIONAL UNITS INVOLVED: INTSOY, Department of Plant Pathology, University of Illinois; and Department of Plant Pathology and Botany, University of Puerto Rico;

COOPERATION: U.S.D.A. Regional Soybean Research Laboratory, Urbana; fellow scientists from Ethiopia, Thailand, Egypt, Iran, and other countries.

FINANCIAL SUPPORT:

Project Leader:
Postdoctorate :
Support :

LITERATURE CITED:

1. Dhingra, O. D., J. F. Nicholson, and J. B. Sinclair. 1973. Influence of temperature on recovery of *Aspergillus flavus* from soybean seed. *Plant Dis. Repr.* 57:185-187.
2. Ellis, M. A., M. B. Ilyas, and J. B. Sinclair. 1974. Effect of cultivar and growing region on internally seed-borne fungi and *Aspergillus melleus* pathogenicity in soybean. *Plant Dis. Repr.* 58:332-334.
3. Ellis, M. A., C. C. Machado, C. Prasartsee, and J. B. Sinclair. 1974. Occurrence of *Diaporthe phaseolorum* var. *sojae* (*Phomopsis* sp.) in various seedlots. *Plant Dis. Repr.* 58:173-176.
4. Ilyas, M. B., O. D. Dhingra, M. A. Ellis, and J. B. Sinclair. 1975. Seed-borne nature of *Diaporthe phaseolorum* var. *sojae* and *Cercospora kikuchii* in soybean. *Plant Dis. Repr.* 57:(In press).
5. Nicholson, J. F., O. D. Dhingra, and J. B. Sinclair. 1972. Internal seed-borne nature of *Sclerotinia sclerotiorum* and *Phomopsis* sp. and their effects on soybean seed quality. Corrected to read: Internal seed-borne nature of *Diaporthe phaseolorum* var. *sojae* (*Phomopsis* sp.) and their effects on soybean seed quality. *Phytopathology* 62:1261-1263.
6. Nicholson, J. F., O. D. Dhingra, and J. B. Sinclair. 1973. Soil temperatures and inoculation techniques affect emergence and reisolation of *Sclerotinia sclerotiorum* from soybean. Corrected to read: Soil temperatures and inoculation techniques affect emergence and reisolation of *Diaporthe phaseolorum* var. *sojae* from soybean. *Mycopath. Mycol. Appl.* 50:179-182.
7. Nicholson, J. F., and J. B. Sinclair. 1971. Amsoy soybean seed germination inhibited by *Pseudomonas glycinea*. *Phytopathology* 61:1390-1393.
8. Nicholson, J. F., and J. B. Sinclair. 1971. *Thialavia basicola* and *Pestalotia* sp. internally seedborne in soybean. *Plant Dis. Repr.* 55:911-912.
9. Nicholson, J. F., and J. B. Sinclair. 1973. Effect of planting date, storage conditions, and seed-borne fungi on soybean seed quality. *Plant Dis. Repr.* 57:770-774.
10. Nicholson, J. F., J. B. Sinclair, and L. K. Joshi. 1973. Seed-borne *Pseudomonas glycinea* and fungi affect soybean seed in India. *Plant Dis. Repr.* 57:531-533.
11. Nicholson, J. F., J. B. Sinclair, and J. C. White. 1974. Survival and entry of *Pseudomonas glycinea* into soybean seed. *Phytopath. Z.* 78:357-364.
12. Schneider, R. W., O. D. Dhingra, J. F. Nicholson, and J. B. Sinclair. 1974. *Colletotrichum truncatum* borne within the seedcoat of soybean. *Phytopathology* 64:154-155.

13. Schneider, R. W., P. N. Thapliyal, and J. B. Sinclair. 1971. Fungi associated with soybean seed from India. *Indian Phytopath.* 24:792-794
14. Sinclair, J. B. 1974. The role of the seed coat in disease control of soybeans. *Proc. 9th Ann. Illinois Soybean Conf.* 22. Illinois Crop Improvement Assn., Urbana.
15. Tenne, F. D., C. Prasartsee, C. C. Machado, and J. B. Sinclair. 1974. Variation in germination and seed-borne pathogens among soybean seedlots from three regions in Illinois. *Plant Dis. Reprtr.* 58:411-413.
16. White, J. C., J. F. Nicholson, and J. B. Sinclair. 1972. Effect of soil temperature and *Pseudomonas glycinea* on emergence and growth of soybean seedlings. *Phytopathology* 62:296-297.

AGRICULTURAL EXPERIMENT STATION

University of Illinois

PROJECT OUTLINE

Project Number

Title

Suppression of soybean pest populations by entomophagous insects and epidemiology of soybean viruses and bionomics of their vectors.

Introduction and Previous Work

Soybean pests often reach high densities in the tropics and subtropics. This is due primarily to a more favorable year-round temperature for the pests. Currently, these high pest populations are being suppressed largely by massive dosages of chemical insecticides. These insecticides result in several unfavorable side effects: 1) they are costly to the farmer, 2) insect pests can develop resistance to them, 3) environmental contamination is great, 4) residual effect of the insecticides can contaminate the newly produced soybean grain, and 5) the natural control agents in the field can be eliminated.

This last effect can so upset the soybean ecosystem that previously non-pest phytophagous species (potential pests) increase and cause economic damage, (i.e. become actual pests). This natural enemy complex in soybean fields around the world is an extremely important buffer to large yield losses. This complex should be studied and its capabilities fully understood so that it can be manipulated to its fullest, thereby reducing insecticides and maintaining high yields for farmers at a low cost/benefit ratio.

The natural enemy complex includes parasitoids, predators and pathogens. The natural enemy portion of the project outline will deal mainly with the entomophagous insects, the parasitoids and predators. Relatively little in a comprehensive way has been written about entomophagous insects of soybean pests. Of the parasitoids, the majority of the work has been done in the United States (e.g. Barry 1970; Burleigh 1971, 1972; Landis and Howard 1940; Lentz and Pedigo 1974, 1975; Pedigo, Stone and Lentz 1972, 1973; Underhill 1934; Whiteside, Burbutis and Kelsey 1967), but a few publications have dealt with other areas of the world (e.g. in India, Gangrade 1974).

Likewise, the predator complex in soybean fields has received most notice in the United States (e.g. Dumas, Boyer and Whitcomb 1962, 1964; Greene 1973; Greene and Shepard 1974; Neal, Greene, Mead and Whitcomb 1972; Neal and Whitcomb 1972; Robinson, Stannard and Armbrust 1972; Shepard, Waddill and Turnipseed 1974; Waddill and Shepard 1974; Waddill, Shepard and Turnipseed 1974). There are very few detailed reports of predators or predator complexes in soybean fields outside North America. Of the few I have in hand, I cite Singh, White and Luckmann 1973; and Gangrade 1974.

Nearly 50 types of viruses attack soybeans, and all but one are known to be transmitted by insects. Insect vectors, therefore, play a major role in the epidemiology of soybean viruses. Viruses, moreover, pose a very serious threat to soybean production, especially in the Tropics, because of the abundance of insect vectors, of other leguminous hosts both for the viruses and their vectors, and the absence of a winter

especially when double virus infections occur (Ross 1968).

There are three major methods of controlling virus spread: develop virus resistant soybean varieties, control seed quality where viruses can be seed born (e.g. soybean mosaic virus), and control the movement and spread of virus vectors. The virus portion of this project outline deals only with the third method.

Soybean virus vectors fall into four main categories: aphids which transmit soybean mosaic virus and many others; beetles (mainly leaf beetles) which transmit cowpea mosaic virus, bean pod mottle virus and others; thrips which transmit tobacco ringspot virus; and whiteflies which transmit many yellow type diseases that are especially severe in the American and Asian tropics.

Several researchers have studied virus-vector relationships in the laboratory (e.g. Bird and Sanchez 1971; Bird, Sanchez and Rodriguez 1974; Costa 1965; Dunleavy 1957, 1973; Flores and Silberschmidt 1966; Koshimizu and Iizuka 1963; Kuhn 1963, 1968; Kuhn, Demski and Harris 1972; Messieha 1969; Nene 1972, 1973; Patel and Pitre 1971; Ross 1963, 1968, 1969; Tamada 1970; Walters 1964), but almost nothing has been studied about virus movement in the field, virus control through vector control or economic injury levels of viruses and their insect vectors. These are important considerations for soybean production in the tropics and in the temperate regions. What information is gained from studies in the tropics can be transferred to virus-vector problems and potential problems in the United States, and vice versa.

Justification and Rationale

Of the various peoples of the world, those inhabiting the tropics and subtropics have the greatest protein deficits. Soybeans containing

a large proportion of high quality protein, are an excellent source for correcting this deficiency. Furthermore, soybeans can be successfully grown under tropical and subtropical conditions, but large-scale production should not be initiated until much more is known about pests and virus disease threatening its success.

Labor-intensive traditional agriculture with small sized fields sown to mixed genetic types, characteristic of developing nations, is not as readily exploited by endemic plant pests as are vast, uniformly genetic monocultures, characteristic of developed nations. Corn in the Midwest, for example, was hit by a dramatic epidemic of corn leaf blight in the early 1970's, a direct effect of a narrow gene base. Crop protection, therefore, might be thought of as more easily achievable in the tropics and subtropics. However, since many of the potential pests and vectors are eliminated from soybean monocultures in developed nations because of long, cold winters, crop protection is more easily attainable in temperate regions. One can imagine the potential hazards with vast plantings of narrow genotype soybeans in the tropics and subtropics, where plant pests and viral diseases abound throughout the year. No matter the region or climate, the need to protect soybeans from pests is great and fully justifiable in terms of economics and yield gains.

The methodologies for crop protection are several and it is important that the most flexible, most economic and longest lasting methodologies be put to use while dangerous, short term methods be discarded. The method of crop protection based solely upon prophylactic use of broad spectrum pesticides is costly and dangerous, and should be

discarded. That based upon overall economic, social and environmental values to optimize pest control should be used. This later method is variously known as "Integrated Control," "Pest Management," and "Integrated Pest Management," and utilizes all suitable techniques and methods in as compatible a manner as possible to maintain pest populations at levels below those causing economic injury (Glass 1975). It has often been discussed and in a few cases demonstrated that careful management of agroecosystems saves farmers money and is environmentally much sounder than prophylactic use of broad spectrum insecticides (e.g. Klassen and Ennis 1974; Metcalf and Luckmann 1975; Quezada et.al. 1974; Ridgeway 1969; Smith 1972; Smith and Huffaker 1973; Teetes et.al. 1975; and Turnipseed 1972,1973).

Within the context of an integrated pest management approach, the naturally occurring entomophagous insects in a soybean field usually exert a considerable suppressive pressure on phytophagous insect populations. They attack pest species at all stages of development. Eggs are parasitized by many families of wasps and are sucked dry by many groups of predators; larvae and nymphs are attacked by many wasp and fly parasites and by predaceous beetles, true bugs, lace wings, thrips, spiders and mites; adults are attacked by fly and wasp parasites and by predaceous flies, beetles, true bugs and spiders. These entomophagous species abound in soybean fields where chemical insecticides have not or only prudently been used, and largely account for continual pest population suppression below economic injury levels. While the species of entomophagous insects differ from one part of the world to another, the entomophagous complex as a whole remains

nearly constant. For example, many species of predaceous bugs occur in soybeans in Illinois and completely different sets of species occur in soybeans in Brazil, in Australia, in Thailand, etc. But in all cases, most of the genera are the same: Nabis, Geocoris, Orius. The same is true of parasitoids and other predators. In effect, natural enemy complexes are homologues of one another, and many of the individual species of a given genus are also ecological homologues, viz. Orius tristicolor (White) in California and Orius insidiosus (Say) in Illinois; each performs a similar role in similar agroecosystems.

Several important research areas need to be pursued regarding entomophagous insects in soybean ecosystems. The following, I feel, have high priority:

1. By methodical sampling and observations, monitor entomophagous species in the soybean ecosystem and record population fluctuations, host species, and apparent ability to regulate host populations.
2. Determine for each of the major parasitoids (usually host specific) and major predators (usually a wide host range) the following: feeding capacity, searching ability, microhabitat preferences, longevity, fecundity, feeding response, affect of intraspecific competition on feeding capacity and searching behavior, and movement patterns in the field.
3. Determine the relative susceptibility of actual pests to attack by entomophagous species in soybean fields planted with pest resistant varieties as compared to normal varieties.
4. Search for and import promising entomophagous species for control of actual pests not under biological control by indigenous natural enemies. These imported species would be laboratory tested, then colonized in areas where target pests were in high numbers.
5. By manipulating the habitat, attempt to augment natural enemies in soybean ecosystems.

6. Determine effect of chemical pesticides on beneficial species.

Consider a recent problem in Illinois. In the spring of 1975, most of the southern half of Illinois suffered the worst outbreak of the soybean thrips, Sericothrips variabilis (Beach), in history. Thrips populations in this area, where about 4.5 million acres are planted to soybeans, commonly exceeded 60 per trifoliate leaf. As the thrips increased in numbers, so did one of its predators, Orius insidiosus. The outbreak was completely controlled by early summer and it is expected that no yield loss will result. No insecticides were recommended and few were used. Several important questions arise out of this experience, among them, these have special importance to my program:

1. Was Orius really responsible of controlling the thrips? How?
2. Do high thrips populations in spring act as nurseries for Orius, permitting them to build up to high numbers and act as significant buffers to other pest outbreaks in mid and late summer?
3. Was there a threat of virus disease epidemic (bud blight) due to the high numbers of thrips?

These questions should be asked, and satisfactory answers must be discovered before another, and potentially more severe, outbreak occurs.

In most parts of the world, soybean is a relatively new crop. Viruses can attack this new crop from natural spread from adjacent areas (usually by vector movement), from movement of viruses already present in other crops, weeds and indigenous vegetation, and with imported germplasm.

Because of their potential to significantly reduce soybean yields and because some viruses can be seed born and thus affect seed quality and breeding programs, soybean viruses should form an important and integral part of any integrated pest management strategy. Unfortunately, much vital information is lacking. For each soybean virus disease the following questions should be answered before a comprehensive strategy can be formulated:

1. Which Arthropods are capable of transmitting the virus? And, under field conditions, which are of major importance in its transmission?
2. What are the biologies of the virus vectors? How long do they live? What are their host ranges? Where do they lay eggs? How many? What are their life cycles? When and where do they overwinter (in temperate regions) or estivate (dry season regions)? What are their mortality factors? Movement patterns? etc.
3. What are the relationships between the vectors and the virus? Acquisition period? Interaction between the virus and the vector? Retention time? Transmission efficiency?
4. How is the virus spread within and between fields? What are the timing factors? What method of vector control will best decrease virus spread? What are the economic injury levels of the virus and its vectors?

Viruses of primary consideration in this outline are those which either have a potentially profound impact on soybeans grown in the tropics and subtropics, or those which directly affect the soybean breeding program. They are soybean mosaic virus (SMV), tobacco ring-spot virus (TRSV), cowpea mosaic virus (CPMV), bean pod mottle virus (BPMV), tobacco streak virus (TSV), and several similar-type yellows mosaic diseases of soybeans caused by virus like agents.

Since pest complexes differ in different parts of the world and since several important virus diseases are presently confined to re-

stricted areas of the world, it seems reasonable and justifiable to initiate the above research in several portions of the soybean growing world. Research is already underway at the University of Illinois at Urbana-Champaign and at the University of Puerto Rico at the Isabela, Lajas and Adjuntas experimental substations. It is herein proposed that further expansion include the University of the Philippines at Los Baños (in cooperation with SEARCA and IRRI); IAPAR, Londrina, Brazil; and an unspecified location in the Middle East; another in West Africa; a location in Central America (probably at the University of El Salvador, San Salvador); and a location in the dry subtropics of Northern Perú (probably at the Vista Florida Experiment Station, Chiclayo).

A direct benefit of virus vector and entomophagous insect work will be a gained knowledge of those agents which can be utilized in helping to protect soybeans in the United States and elsewhere. Proven parasitoids and predators can be introduced to help control pest species; knowledge about viruses and their potential vectors can be quickly put to use if some virus is accidentally introduced into the United States.

It is of the utmost importance that we learn to manage the natural control agents in soybean fields more effectively and that we evaluate the importance of insect vectors in the spread of virus diseases in soybean fields. The proposed research will fulfill these objectives and in so doing will encourage and stimulate related research by scientists around the world, develop, through student assistantships, competent young researchers to further explore these

major objectives, assemble and disseminate pertinent literature and other means of knowledge about these major objectives, and assist plant breeders in producing tolerant or resistant soybean varieties to major pests and virus vectors.

Goals and Objectives

The overall goal of the program, of which ^{the} my project is an integral part, is to devise and disseminate technology needed to implement soybean pest management programs, emphasizing tropical and subtropical areas.

Specific objectives of ^{the} my project are to assemble relevant literature on, and, through basic and applied research, help provide information crucial to

- I the management, manipulation and augmentation of entomophagous insects in soybean ecosystems to maximize their suppressive effect on populations of insect pests, and
- II the management and control of insect vectors to minimize spread of soybean viruses within and between fields, and to insure low incidence of virus in soybean seed.

Procedures

To implement objective I, the following will be undertaken:

1. Prepare a data file by assembling existing literature (using facilities of the Soybean Insect Research Information Center) and specimen data (housed in the International Reference Collection of Soybean Arthropods).

The file will include the following types of information:

- a. list of all key and occasional soybean insect pests in the world.
- b. map of the known distribution of each listed pest.

- c. list of alternate host plants (especially crops) of each listed pest.
- d. list of parasites of each listed pest.
- e. map of the known distribution of each parasite and hyperparasite.
- f. list of known host range of each parasite and hyperparasite.
- g. summary of knowledge of effectiveness of each parasite on each host pest in each crop per region.
- h. list of all known predators of each listed pest.
- i. list of all known hosts of each predator.
- j. map of the known distribution of each genus of predator, indicating regions where single species occur and where overlaps in species distributions occur.
- k. summary of knowledge of effectiveness of each predator on each host pest (and on other beneficial insects) in each crop per region.
- l. the data file will include a bibliography which will be updated as new sources of information are located or become available.
- m. the data file will be computer-based for easy access and updating capabilities.
- n. the entire data file will be updated as new information pertinent to topics (a-k) are discovered.
- o. this file will, at the end of five years, form a portion of a book on Soybean Insects of the World.

A study will be conducted of the effect of plant resistance on the efficiency of natural enemies. Kogan (p. 139, in Metcalf and Luckmann 1975) described a model proposed by S. Bombasch in which, on a susceptible host plant, predators were unable to control a particular host, but on a resistant host plant, they were. A similar example by K. J. Starks (p. 140, in Metcalf and Luckmann 1975) using parasites instead of predators demonstrated a like effect. This particular subproject will be jointly researched by Dr. Marcos Kogan and me. We will confine our initial experimentation to systems in which host plant resistance is well documented.

- a. a laboratory experiment will be initiated using the soybean looper, Pseudoplusia includens, as the pest and a pentatomid, Podisus maculiventris, as the predator. After initial indications of effect of pest population suppression on resistant vs. susceptible lines, the experiment will be expanded in the field under screened cages.
- b. a similar series of experiments will be initiated using the Mexican bean beetle, Epilachna varivestis, as the pest and an eulophid wasp, Pediobius foveolatus, as the parasite.
- c. these sets of experiments will lay the foundation for a comparable program between biological control and breeding for plant resistance.

A study will be initiated on the capabilities of Orius spp. (Hemiptera:Anthocoridae) to control key and occasional pests in soybeans. This will be undertaken in cooperation with Dr. L. J. Stannard. The various species of Orius are known to be extremely important in the population suppression of mites, thrips and lepidopterous pests in soybean. Different species occur in different parts of the world. I propose to study the following aspects of Orius:

- a. survey literature (with the help of the Soybean Insect Research Information Center) and soybean fields (with the help of the International Research Collection of Soybean Arthropods) to compile a detailed catalogue of Orius and where they occur in the world.
- b. population dynamics of Orius spp., emphasizing comparative aspects. Included in this will be laboratory culturing of as many species of Orius as I am able to rear. I will be looking closely to comparative abilities of the various species with regard to searching behavior, feeding capacity, intraspecific competition, and species displacement capabilities.
- c. field biology of one or two species of Orius will be undertaken. Orius insidiosus will be studied because it occurs in Urbana and because of its wide geographical distribution, occurring throughout South and Central America. One other species, O. tristicolor occurring in the western part of North America and at least as far south as Colombia, may also be studied in detail. The overwintering habits and habitats as well as movement patterns will be studied.

- d. the introduction of some species of Orius into areas not containing endemic aggressive species will be undertaken.
- e. the ability of Orius spp. to survive dosages of insecticides has not been studied thus far, and thus will form a part of this study.
- f. a comprehensive bibliography will be initiated on Orius, with the critical help of SIRIC.
- g. a comprehensive paper on Orius, stressing comparative biology and potential as biological control agents will be undertaken at the end of this project outline renewal date.

Objective II above will be developed jointly by Dr. R. M. Iman and myself. To impl^{ment} this objective, the following will be undertaken:

Prepare a computer-based data file on viruses and their vector in soybeans by assembling existing literature (using SIRIC facilities and soybean disease compendium) and specimen data (using IRCSA facilities). The data file will include what is known in the following categories:

- a. list of all viruses and virus-like agents known to cause diseases in soybeans.
- b. map of the distribution of each virus and virus-like agent.
- c. description of disease symptoms of viruses and virus-like agents on soybeans.
- d. list of alternate plant hosts of each virus and virus-like agent.
- e. list of vectors of each virus and virus-like agent.
- f. map of the distribution of each vector species.
- g. list of the host range of each vector species.
- h. list of the virus and virus-like agent transmissible by each vector species.

- i. summary of knowledge about the relationship of each virus and virus-like agent and its vector(s), including virus acquisition, retention and transmission, and field epidemiology.
 - j. this data file will form the basis of a publication on soybean viruses and their vectors.
2. Work out the relationship of tobacco ring spot virus (TRSV) which causes bud blight disease of soybeans and its vectors, especially those belonging to the order Thysanoptera. Include will be virus disease spread in the field, the mechanism of spread, mechanism of acquisition, retention and transmission, alternate hosts, and mode of overwintering for the vector(s).
3. A study of leaf-beetle transmitted viruses will be initiated. The principal viruses will be bean pod mottle virus (BPMV) and cowpea mosaic virus (CPMV). The principal vectors of both viruses are members of the genus Cerotoma. Dr. M. Kogan and Dr. G. P. Waldbauer have begun an intensive study of the bean leaf beetle, Cerotoma trifurcata, in Illinois, and Dr. W. G. Ruesink has begun to model this pest in soybeans. Dr. G. M. Milbrath and one of this graduate students have begun a detailed study of BPMV. Dr. R. M. Goodman and I propose to take advantage of the wealth of expertise now existing on the University of Illinois campus and study the interaction of the virus with the beetle, follow the movement patterns of both, and attempt to understand the relationship between beetle, virus and soybean yield and seed quality. We wish to establish economic injury levels and will work closely with Dr. W. G. Ruesink in forming a model of the beetle, the virus, and soybeans.
4. A study has already begun on soybean mosaic virus (SMV) and its spread in fields. While SMV is generally not an important virus from the standpoint of grain yield, it is extremely important from the standpoint of seed quality and maintenance of viable breeding lines. In order to eliminate SMV from breeding lines, much about its epidemiology must be learned. We know that SMV is seed born and transmitted by aphids. Our field trials are currently being conducted at the Isabela experimental substation, University of Puerto Rico, and at the University of Illinois at Urbana-Champaign. What we hope to learn from our current studies are the following:
 - a. how much spread of SMV occurs under actual field conditions?
 - b. what aphid species are flying during field spread?

- c. what are the species responsible for the spread of SMV?
 - d. in what direction are they flying?
 - e. how long can SMV, a nonpersistent virus, be retained by an aphid vector?
 - f. how far can such an aphid fly and still be able to transmit the virus?
 - g. how can germplasm be planted so as to minimize spread of SMV, taking into account aphid behavior and phenology?
5. One of the most important groups of diseases of tropically grown soybeans is the "yellows" complex which is caused by virus-like agents. They are known to be transmittable by a few species of whitefly, mainly Bemisia tabaci. A concerted effort will be made to gather pertinent literature on this subject and to devise some experiments concerning the interrelationship of vector and virus-like agent. All experimental work will have to be done in other countries where the virus and whiteflies occur.
6. A program will be established to screen candidate germplasm for resistance to viruses and vectors. This resistant or tolerant germplasm will then be incorporated into the INTSOY breeding program.

Duration

Five years, with revision at the end of this period.

Personnel

Project Leader

Michael E. Irwin Univ. of Ill. and Ill. Nat. Hist. Survey

Cooperating Personnel

Raul Abrams	Univ. of Puerto Rico, Mayagüez
J. K. Bouseman	Univ. of Ill. and Ill. Nat. Hist. Survey
G. L. Godfrey	Univ. of Ill. and Ill. Nat. Hist. Survey
R. M. Goodman	Univ. of Illinois
Marcos Kogan	Univ. of Ill. and Ill. Nat. Hist. Survey
H. C. Minor	Univ. of Illinois
E. H. Paschal II	Univ. of Illinois
P. W. Price	Univ. of Illinois
W. G. Ruesink	Univ. of Ill. and Ill. Nat. Hist. Survey
L. J. Stannard	Univ. of Ill. and Ill. Nat. Hist. Survey
G. P. Waldbauer	Univ. of Ill. and Ill. Nat. Hist. Survey

Potential Cooperators

E. J. Armbrust	Univ. of Ill. and Ill. Nat. Hist. Survey
D. P. Bartell	Univ. of Ill. and Ill. Nat. Hist. Survey
G. L. Greene	University of Florida
P. L. Meléndez	University of Puerto Rico
G. M. Milbrath	Univeristy of Illinois
L. R. Nault	Ohio Agric. Res. Develop Center, Wooster.
L. D. Newsom	Louisiana State University
L. P. Pedigo	Iowa State University
B. M. Shepard	Clemson University
J. D. Unzicker	Illinois Natural History Survey
W. H. Whitcomb	University of Florida

Institutional Units Involved

Presently Cooperating Institutes and Universities

University of Illinois

Department of Agricultural Entomology
 Department of Plant Pathology
 Department of Agronomy
 Department of Entomology
 International Soybean Program (INTSOY)

Illinois Natural History Survey

Section of Economic Entomology
 Section of Faunistic Surveys

University of Puerto Rico

International Soybean Program (INTSOY)
 Department of Agronomy

Potentially Cooperating Institutes and Universities

University of Florida

Clemson University

Louisiana State University

Iowa State University

Ohio Agricultural Research and Development Center

University of Los Baños, Philippines

Vista Florida Experimental Station, Perú

Instituto Agronomico do Paraná (IAPAR), Londrina, Brazil

University of El Salvador

Cooperation

This project will be built upon scientific and institutional cooperation. Most of the virus vector research will be conducted jointly

with R. M. Goodman (virologist), Department of Plant Pathology, University of Illinois. Much of the entomophagous insect research will be conducted in cooperation with Marcos Kogan (entomologist) and with L. J. Stannard (entomologist), both of the Illinois Natural History Survey and University of Illinois. Several institutions and Universities and their researchers will play a major role in the development of this project: the University of Puerto Rico, IAPAR (Londrina, Brazil), University of Illinois, University of the Philippines, and many others.

Literature

- Barry, R.M. 1970. Insect parasites of the green cloverworm in Missouri. J. Econ. Entomol. 63(6):1963-1965.
- Bird, J. and J. Sanchez. 1974. Whitefly-transmitted viruses in Puerto Rico. J. Agr. Univ. Puerto Rico 55:461-467.
- Bird, J., J. Sanchez and R.L. Rodriguez. 1974. Viruses affecting soybeans in Puerto Rico. Proc. Workshop on Soybeans for Tropical and Subtropical Conditions, INTSOY Publ. 2:109-111.
- Burleigh, J.G. 1971. Parasites reared from the soybean looper in Louisiana 1968-69. J. Econ. Entomol. 64(6):1550-1551.
- Burleigh, J.G. 1972. Population dynamics and biotic controls of the soybean looper in Louisiana. Environ. Entomol. 1(3):290-294.
- Costa, A.S. 1965. Three whitefly-transmitted virus diseases of beans in San Paulo, Brazil. FAO Plant Protec. Bull. 13:121-130.
- Dumas, B.A., W.P. Boyer and W.H. Whitcomb. 1962. Effect of time of day on surveys of predaceous insects in field crops. Fla. Entomol. 45(3):121-128.
- Dumas, B.A., W.P. Boyer and W.H. Whitcomb. 1964. Effect of various factors on surveys of predaceous insects in Soybeans. J. Kansas Entomol. Soc. 37(3):129-201.
- Dunleavy, J.M. 1957. The grasshopper as a vector of tobacco ringspot virus in soybean. Phytopathology 47:681-682.
- Dunleavy, J.M. 1973. Viral diseases, Chapter 15:505-526; In B.E. Caldwell (Ed.) "Soybeans: Improvement, Production, and Uses." American Society of Agronomy, Madison, WI.
- Flores, E., and K. Silberschmidt. 1966. Studies on a new virus disease of Phaseolus longepedunculatus. Anais da Academia Brasileira de Ciencia 38:327-334.
- Gangrade, G.A. 1974. Insects of soybeans. Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India. Tech. Bull. 24:1-88.
- Glass, E.H. (Coordinator). 1975. Integrated pest management: rationale, potential, needs and implementation. Entomol. Soc. Amer. Special Publ. 75-2, 141 p.
- Goodman, R.M. 1975. Important nematode and virus diseases of soybeans, "Proc. Soybean Production, Protection and Utilization," INTSOY Publ. 6:132-140.

- Greene, G.L. 1973. Biological studies of a predator, Sycanus indagator. I. Life history and feeding habits. Fla. Entomol. 56(3):255-257.
- Greene, G.L. and M. Shepard. 1974. Biological studies of a predator, Sycanus indagator. II. Field survival and predation potential. Fla. Entomol. 57(1):33-38.
- Klassen, W. and W.B. Ennis, Jr. 1974. The role of pesticides in pest management. Span, March 17, 1974:128-130.
- Koshimizu, Y. and N. Iizuka. 1963. Studies on soybean virus diseases in Japan. Tohoku (Japan) Natl. Agr. Expt. Sta. Bull. 27:1-103.
- Kuhn, C.W. 1963. Field occurrence and properties of the cowpea strain of southern bean mosaic virus. Phytopathology 53:732-733.
- Kuhn, C.W. 1968. Identification and specific infectivity of a soybean strain of cowpea chlorotic mottle virus. Phytopathology 58:1441-1442.
- Kuhn, C.W., J.W. Demski and H.B. Harris. 1972. Peanut mottle virus in soybeans. Plant Dis. Repr. 56:146-147.
- Landis, B.J. and N.F. Howard. 1940. Paradexodes epilachnae, a tachinid parasite of the Mexican bean beetle. U.S. Dep. Agr. Tech. Bull. 721:1-31.
- Lentz, G.L. and L.P. Pedigo. 1974. Life history phenomena of Rogas nolophanae and Winthemia sinuata, parasites of the green cloverworm in Iowa. J. Econ. Entomol. 68(3):301-304.
- Messieha, M. 1969. Transmission of tobacco ringspot virus by thrips. Phytopathology 59:943-945.
- Metcalf, R.L. and W.H. Luckmann (Eds.). 1975. Introduction to insect pest management. John Wiley and Sons, New York. 587 p.
- Neal, T.M., G.L. Greene, F.W. Mead and W.H. Whitcomb. 1972. Spanogonicus albofasciatus: a predator in Florida soybeans. Fla. Entomol. 55(4):247-250.
- Neal, T.M. and W.H. Whitcomb. 1972. Odonata in the Florida soybean agroecosystem. Fla. Entomol. 55(2):107-114.
- Nene, Y.L. 1972. A survey of viral diseases of pulse crops in Uttar Pradesh. University, Press, Pantnagar, India.
- Nene, Y.L. 1973. Viral diseases of some warm weather pulse crops in India. Plant Dis. Repr. 57:463-467.
- Patel, V.C. and H.N. Pitre. 1971. Transmission of bean pod mottle virus to soybean by the striped blister beetle, Epicauta vittata. Plant Dis. Repr. 55:628-629.

- Pedigo, L.P., J.D. Stone and E.L. Lentz. 1972. Survivorship of experimental cohorts of the green cloverworm on screenhouse and open-field soybean. *Environ. Entomol.* 1(2):180-186.
- Pedigo, L.P., J.D. Stone and G.L. Lentz. 1973. Biological synopsis of the green cloverworm in central Iowa. *J. Econ. Entomol.* 66(3):665-673.
- Quezada, J.R., C. Cornejo, A. Diaz de Mira and F. Hidalgo. 1974. Control biologico e integrado de la mosca prieta de los citricos en El Salvador. Univ. de El Salvador, Facultad de ciencias y Humanidades, Instituto de Ciencias Naturales y Matematicas, Dept. de Biologia. 39 p.
- Robinson, A.G., L.J. Stannard and E.J. Armbrust. 1972. Observations on predators of Sericothrips variabilis Beach. *Entomol. News* 83:107-111.
- Ross, J.P. 1963. Transmission of bean pod mottle virus in soybeans by beetles. *Plant Dis. Repr.* 47:1049-1050.
- Ross, J.P. 1968. Effect of single and double infections of soybean mosaic and bean pod mottle viruses on soybean yield and seed characters. *Plant Dis. Repr.* 52:344-348.
- Ross, J.P. 1969. Pathogenic variation among isolates of soybean mosaic virus. *Phytopathology* 59:829-832.
- Shepard, M., V. Waddill and S.G. Turnipseed. 1974. Dispersal of Geocoris spp. in soybeans. *J. Georgia Entomol. Soc.* 9(2):120-126.
- Singh, Z., C.E. White and W.H. Luckmann. 1973. Notes on Anyotea malabarica, a predator of Nezara viridula in India. *J. Econ. Entomol.* 66(2):551-552.
- Smith, R.F. 1972. Management of the environment and insect pest control. FAO Conf. "Ecology in Relation to Plant Pest Control," Rome, Dec. 11, 1972:1-19.
- Smith, R.F. and C. B. Hufaker. 1973. Integrated control strategy in the United States and its practical implementation. *OEPP/EPPB Bull.* 3(3):31-49.
- Tamada, T. 1970. Aphid transmission and host range of soybean dwarf virus. *Ann. Phytopath. Soc. Japan* 36:266-274.
- Teetes, G.L., R.C. McIntyre, N.M. Randolph, N.E. Daniels, and R.L. Haney. 1975. Integrated control cuts insecticide costs and usage. *Texas Agr. Progress* 21(2):4-7.

- Turnipseed, S.G. 1972. Management of insect pests of soybeans. Tall Timbers Conf. "Ecol. Anim. Control Habitat Manage.", Proc. 4:189-20
- Turnipseed, S.G. 1973. Insects, chapter 17, pp. 545-572; In B.E. Caldwell (Ed.), "Soybeans: Improvement, Protection, and Uses." American Society of Agronomy, Madison, WI.
- Underhill, G.W. 1934. The green stinkbug. Virginia Agr. Exp. Sta., Bull. 294:1-26.
- Waddill, V. and M. Shepard. 1974. Potential of Geocoris punctipes and Nabis spp. as predators of Epilachna varivestis. Entomophaga 19(4):421-426.
- Waddill, V., B.M. Shepard, S.G. Turnipseed and G.R. Carner. 1974. Sequential sampling plans for Nabis spp. and Geocoris spp. on soybeans. Environ. Entomol. 3(3):415-419.
- Walters, H.J. 1964. Transmission of bean pod mottle virus by bean leaf beetles. Phytopathology 54:240.
- Whitcomb, W.H., H.A. Denmark, A.P. Bhatkar and G.L. Greene. 1972. Preliminary studies on the ants of Florida soybean fields. Fla. Entomol. 55(3):129-142.
- Whiteside, R.C., P.P. Burbutis and L.P. Kelsey. 1967. Insect parasites of the green cloverworm in Delaware. J. Econ. Entomol. 60(2):326-328.

INTSOY INTERNATIONAL SOYBEAN PROGRAM

COLLEGE OF AGRICULTURE
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
13 MUMFORD HALL, URBANA, ILLINOIS 61801 USA, CABLE: INTSOY, TELEPHONE (217) 333-6422

November 21, 1975

NOV 26 1975

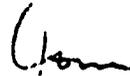
Dr. Willard H. Garman, Chief
Food Crop Division
Office of Agriculture
Bureau of Technical Assistance
Room 2239 New State Building
Washington, D.C. 20523

Dear Jess:

You may remember when Bill, Keith and I were having lunch with you, Dr. Hesser and others on November 10 the discussion reached a point at which Bill referred to procedures by which research conducted by INTSOY staff members under contract AID/CM/ta-c-73-19 were integrated into the College of Agriculture Experiment Station. Bill indicated that for each area of research under the contract specific project proposals had been prepared, submitted to the Experiment Station for review and approval and had been made a part of the Experiment Station total program. He promised to send copies of these research statements to you as they express in greater detail than we are able to do in a project summary statement the research objectives of the INTSOY staff in the several disciplines involved. Copies of these proposals are enclosed. I hope you will share these with Dr. Hesser and others.

Best wishes.

Sincerely,



Thomas A. McCowen
Assistant Director

TAM:dt
enc.

cc: W. N. Thompson

1. Project Number:

2. Title: Improvement of Soybean Production in the Tropics, Subtropics and Temperate Zones of the World

3. Previous Work:

Most of the recent soybean improvement work has been done in the United States. Efforts have concentrated on developing varieties better adapted for production in the temperate climates from 30° to 45° N latitude. The influence of environment change on soybean development has been examined (1 thru 14) in the U.S. and selected other countries.

Research programs for improving soybeans do exist in Brazil, Colombia, India, Nigeria, Indonesia, Taiwan, and other countries. However, soybeans are not a staple food in these countries and the research programs are restricted. Wide range evaluation of available soybean germplasm has not been completed. Such work will serve as guidelines for developing material better adapted to regions of the world where soybeans are not currently grown. Pest problems are expected to be many fold greater in parts of the tropics as seasonal change does not break the life cycle of pest organisms. Temperature and moisture regimes are usually favorable for pest multiplication. Light sensitivity in soybeans results in plants of short stature and low pod height when grown at low latitudes. Warm, humid environments are not favorable for obtaining high quality seed. Production practices must be identified to maximize grain yield for different environments.

4. Justification:

Soybeans have a great potential for supplying quality protein to the diets of malnourished people in less developed countries. In many environments the soybean is capable of producing more protein per unit area of land than any other crop. Edible oil is also an important product of the soybean. Therefore, the crop is important to those areas where

The research will be conducted at the Agronomy South Farm, University of Illinois; Experiment Stations in Puerto Rico and selected locations throughout the world. The many locations are necessary to evaluate material, methods and techniques of soybean improvement.

Identification of material and methods for improving soybean production is essential for future expansion of the crop and elimination of malnutrition in the developing world. The research outlined in this proposal is important for improving soybean production in the world.

5. Objectives:

1. To improve crop production practices which will permit efficient soybean production.
2. To determine the fertility needs of tropical soils as they relate to soybean production.
3. To determine the compatibility of Rhizobium bacteria in soil environments of the world and to introduce efficient strains of the bacteria.
4. To identify the best adapted available improved strains and to develop even more superior soybean types for tropical and temperate areas.

6. Procedure.

1. Cooperate with local scientists to determine a package of practices for the areas which have potential for expanding soybean production.
 1. Investigate the environmental conditions to determine the best time of planting soybeans. Establish "date of planting" trials on a biweekly basis during the most favorable period(s).
 2. Make preliminary studies to determine the growth habits of the best adapted varieties. Use growth habit information to determine plant population and row spacing recommendations.

Establish population and spacing trials for adapted varieties.

3. Crop-sequence trials will be conducted at locations selected for adequate representation of major zonal conditions.

B. Soil fertility needs will be determined for optimum soybean production in the various soils of the world.

1. Studies of requirements for major nutrients, such as nitrogen (N), phosphorus (P), and potassium (K), will be conducted at a few principal locations. Attention will be paid to the possibility of genotype-nutrient interactions.

2. Minor nutrient elements will be studied as they relate to effective soybean production.

3. Attention will be given to the problems of acidity (low pH) and alkalinity (high pH) as they affect soybean production and Rhizobium populations. Efficient methods of correcting acidity and alkalinity will be studied.

C. Studies will be made to determine the compatibility of commercially available soybean inoculants in soil environments. Selected locations will be used for the introduction of individual Rhizobium strains to study their efficiency and ability to compete with local soil micro-organisms. Problems of local inoculant manufacture will be studied at a few locations.

D. Studies will be conducted to identify the best adapted available improved strains and to develop superior soybean types for the tropics, subtropics, and temperate areas.

1. Breeding of new strains will be undertaken in cooperation with national and regional programs of cooperating agencies. The primary goal of the breeding program is the development of high-yielding, high-quality soybean varieties. Particular attention will be given to

... characters already found in improved

varieties, with better ecological adaptation to the growing conditions of developing countries and with resistance to major disease and insect pests. The results of the INTSOY Variety Trials will be utilized to select parental material for the hybridization-selection programs to be conducted in Puerto Rico. A strong interdisciplinary approach will be emphasized in the breeding program, with specialists in the fields of plant pathology, entomology, agricultural engineering, and plant physiology contributing in the areas of problem identification and development of breeding methodologies. Attention will be paid to broad-scale adaptation, since environmental variability is presently a serious deterrent to the use of available improved varieties. Physically, much of the breeding and selection work must be done at selected cooperating sites, where trained plant breeders are operating. Early and advanced generation selected material will be distributed to cooperating breeders for further selection and evaluation. Breeding populations combining characteristics of special value will be developed, maintained at the Puerto Rico site, and distributed on request to plant breeders in cooperating areas. Close cooperation will be maintained with varietal development activities in cooperating countries, with the objectives of (1) formulating breeding pools combining the widest possible range of desired characteristics, (2) obtaining broad-scale testing of new selections, and (3) strengthening local breeding programs by free interchange of materials and technical information.

2. A strong early effort will be to continue and expand major zonal trials now being conducted by the University of Illinois under its AID contract program, at locations representing the main agro-climatical zones of the world. These trials, as now conducted, consist of 15 improved varieties. The trials will be repeated in each principal

growing season, at each test location. They will focus on grain yield, maturity, chemical composition, and major agronomic characters affecting the practical usefulness of the variety under a wide range of environments. Zones of study will include:

- (1) Latitude zones of 10° units
- (2) Altitude zones of 500M units

Examples being: Zone 1 = $\leq 10^\circ$ latitude and ≤ 500 meters altitude; and Zone 4 = $\leq 10^\circ$ latitude and 501 to 1000 meters altitude; etc.

3. Preliminary trials of promising new strains will be conducted at a few selected locations in each zone. Such trials typically will include new selections from breeding programs at Illinois, in Puerto Rico, and in cooperating countries, plus a few varieties of known excellent performance as standards for control. The major purpose of these trials will be to evaluate broad-scale adaptation of new types which are identified as high-performing in their areas of origin. These preliminary trials will be conducted at locations typical of important agroclimatic zones, and where experience has indicated that successful trials can be grown.

7. Duration:

Five years

8. Personnel:

C. N. Hittle

E. H. Paschal II

D. K. Whigham

R. E. Dunker

9. Institutional Units Involved:

10. Cooperation:

Primary cooperation will be with INTSOY Entomologists and Pathologists at the University of Illinois and with the University of Puerto Rico, Agronomy Department, Mayaguez Campus. Cooperation will also include government officials, university staff and other persons interested in soybean production and research from individual countries throughout the world. International crop research centers interested in soybeans will also be involved.

11. Financial Support:

Financial support will come through the International Soybean Program (INTSOY).

LITERATURE CITATIONS

1. Basnet, B., E. L. Mader, and C. D. Nickell. 1974. Influence of altitude on seed yield and other characters of soybeans differing in maturity in Sikkim (Himalayan Kingdom). *Agron. J.* 66:531-533.
2. Brown, D. M. 1960. Soybean ecology I. Development - Temperature relationships from controlled environment studies. *Agron. J.* 52:493-496.
3. Brown, D. M., and L. J. Chapman. 1960. Soybean ecology II. Development - Temperature - Moisture relationships from field studies. *Agron. J.* 52:496-499.
4. Cartter, J. L., and T. H. Hopper. 1942. Influence of Variety, environment, and fertility level on the chemical composition of soybean seed. U.S. Dept. Agr. Tech. Bull. 787.
5. Cartter, J. L. 1958. Time of planting studies. *Northern state Soybean Dig.* 18 (7): 12-14.
6. Garner, W.W., and H. A. Allard. 1930. Photoperiodic response of soybeans in relation to temperature and other environmental factors. *J. Agr. Res.* 41 (10): 719-735.
7. Hartwig, E. E. 1954. Factors affecting time of planting soybeans in the Southern states. *USDA Circ.* 943.
8. Hartwig, E. E. 1970. Growth and reproductive characteristics of soybeans (Glycine max (L.) Merr.) grown under short-day conditions. *Trop. Sci.* 12: 47-53.
9. Hartwig, E. E. 1973. Chap. 6. Varietal Development. In Soybeans: Improvement, Production and Uses. B. E. Caldwell (Ed.), Number 16 in the series AGRONOMY. American Society of Agronomy, P. 187-210.
10. Howell, R. W. 1956. Heat, drought and soybeans. *Soybean Dig.* 16 (10): 14-17.

11. Hymowitz, T., J. W. Dudley, F. I. Collins, and C. M. Brown. 1974. Estimations of protein and oil concentration in corn, soybean, and oat seed by near-infrared light reflectance. *Crop Sci.* 14: 713-715.
12. Johnson, H. W., H. A. Borthwick, and R. C. Leffel. 1960. Effects of photoperiod and time of planting on rates of development of the soybeans in various stages of the life cycle. *Bot. Gaz.* 122: 77-95.
13. Runge, E. C. A., and R. T. Odell. 1960. The relationship between precipitation, temperature, and yield of soybeans on the Agronomy South Farm, Urbana, Illinois. *Agron. J.* 52: 245-247.
14. Thompson, L. M. 1970. Weather and technology in the production of soybeans in the Central United States. *Agron. J.* 62: 232-236.

SOYBEAN PRODUCTION AND UTILIZATION

I. Introduction

- A. Research conducted, with AID funding, by the Universities of Illinois and Puerto Rico has clearly shown that commercial high yielding U. S. soybean varieties, particularly those used widely in our southern states, will produce equally high yields in tropical and subtropical areas when grown under carefully controlled conditions with respect to planting density, pesticide application, Rhizobium inoculation, fertilization and moisture, insect and disease control. A considerable part of the cultural practice package for tropical production of soybeans is available but because of the sensitivity of the soybean to specific local environmental conditions, the full package, including the development of varieties with specific resistance to local limiting insect pests and disease, and adaptability to other local conditions of soil and climate, must be achieved in the country where increased production of soybeans is to be undertaken. Special breeding activities are currently underway at the Universities of Illinois and Puerto Rico to develop varieties and populations more broadly suited to tropical and subtropical conditions.

While the adaptive research is under way, the country involved would begin to benefit from the many advantages the soybean offers; high yields of total edible food, high yields of good quality protein and improvement of soil fertility. Since the soybean will be most valuable, in typical small farmer cropping systems where it is grown intermixed with other crops, the risk of serious insect and disease problems normally encountered in intensive large scale monocultural production would be minimized and the advantages the soybean as a source of nitrogen and as a soil improver would reach an optimum level.

The technology described meets the criteria upon which the OAA program is based, namely:

1. The soybean is capable of producing higher yields of high quality edible protein per unit of land area than any other vegetable or animal food source under tropical conditions;
2. The quality of the protein of the soybean is such that it can make a substantial improvement in the protein

intake of humans, and food animals, in the developing world with consequent benefits to the status of human nutrition; and

3. To be used as food or feed, the soybean must undergo some simple processing steps. These processes can easily be conducted at the home or farm level and, with limited sophistication of equipment, are equally adaptable to village or regional scale processing to produce a variety of acceptable and nutritious food and feed products, including, for example, whole fat soybean flour for the fortification of wheat flour and other cereal staples. These industries, however small, can provide needed employment and consequent better distribution of income. It should be noted that the processes considered do not include solvent extraction, or further refinement of defatted soybean meal into protein concentrates, isolates, etc. Such processes are capital intensive and must be carried out on a scale completely beyond the capacity of most LDCs to sustain on a viable basis.

Additionally, the soybean, when inoculated with the nitrogen fixing rhizobia bacteria, obtains its own nitrogen from the air and provides a surplus of available nitrogen for crops grown with it, or immediately following. With the growing scarcity, and increasing cost, of nitrogenous fertilizers, the use of soybeans in a mixed cropping system becomes extremely important, particularly for the small farmer.

The readiness of the technology of soybean production for transference to tropical and subtropical conditions is evidenced by the progress that has already been made in introducing the soybean into the Philippines, Thailand, Colombia and India where extensive national research and development programs are under way.

Over the past several years, many LDCs have shown interest in developing soybean production to improve their agriculture and to meet critical national needs for more protein for their population and their food animals. The depth of interest displayed indicates quite clearly that the rational development of soybean production in the LDCs would command the interest and strong commitment of the governments concerned.

The introduction of soybean production and utilization in the LDCs can be implemented by the many sources of expertise available to AID. INTSOY, a joint venture of the Universities of

Illinois and Puerto Rico, has carried out the bulk of AID effort to date. The University of Puerto Rico has developed considerable data on cultural practices under conditions closely duplicating those in Haiti. Competence also exists at several other U. S. Land Grant Universities, particularly Iowa State, Purdue, Ohio State, Florida, Mississippi State, Nebraska and North Carolina State, and in the Agricultural Research Service of the U. S. Department of Agriculture. There is also expertise available from consultants in the private sector. All of this competence can be brought to bear on the development of soybean production in the LDCs and the introduction of the technology can be easily be managed and coordinated by the AID direct hire staff.

- B. Haiti, Tanzania and Nigeria are suggested as the primary target countries for soybean production development. Haiti has an urgent need for more food, more feed and more protein, and further needs a means of restoring soil fertility in the virtual absence of ability to afford high inputs of chemical fertilizers and other external inputs. The favorable climate of the country leads the Haitian small farmer to use mixed cropping extensively in order to get the utmost yield from his small parcel of land. The soybean lends itself particularly well to this situation by providing, via the symbiotic rhizobia bacteria, nitrogen and a good yield of high protein food to complement the other crops, cereals, cassava, yams, maize, etc., grown in close rotation or in an intermixed pattern. The soybean, as a new crop, will be a particularly good crop around which the presently almost moribund agricultural research, extension, and marketing institutions of Haiti can be revived and in which a pool of trained and highly trainable people can be constructively involved. The nearness of the country to the U. S. mainland and the Commonwealth of Puerto Rico will facilitate supervision and consulting activities and the improved well-being of the country is greatly to be desired as a key factor in the overall development and well-being of the Caribbean.

An active and effective Mennonite Mission, working closely with the small farmers in Haiti offers an excellent media for mounting the second phase of the project as discussed later. This Mission has trained agronomists working on practical farming problems and in close rapport with the small farmers and the rural poor.

Tanzania and Nigeria have both shown continued interest in developing soybean production. Nigeria actually grows some soybeans for export but is now orienting its interest in soybeans to its internal market and needs. Both countries have small soybean research programs under way. The two countries have a more active and viable infrastructure, in terms of research, marketing and distribution facilities, than has Haiti. The need for additional food and feed, and particularly protein to improve the essentially starchy diet is almost as great as in Haiti. Both countries have large areas of land well-suited to soybean production. Distance would add to the management problem but, on the other hand, the more active institutional infrastructure would simplify the implementation of a development program and probably enable it to reach a self-sustaining basis more quickly than in Haiti. The choice of the priority target country will obviously be influenced by the interest of the country itself and by a detailed assessment by a specialized team.

- C. Soybean production development in any LDC must consider production and utilization together since soybeans will usually be a new crop and a new food. Farmers and consumers must, therefore, not only learn how to grow the crop to gain the advantage of all its benefits, but also how to use the beans for food and feed. To deal with this, an integrated systematic approach must be followed which will stress these two areas, as well as other factors in the overall marketing system which must be developed such as seed supply, credit, processing and distribution.

With regard specifically to Haiti, the major problem is that the research, extension, marketing, credit, pricing policy, transport and other essential institutional factors are currently nonexistent or extremely moribund, except for a few institutions dealing with coffee, an important export crop. The other institutions exist only on paper, or as small underpaid groups without facilities or tasks. This is the result of years of neglect and not because of any lack of talent. Presently, there are few trained agricultural scientists in Haiti; most have sought to advance their professional careers abroad but a revived and effective national program could lure many of these back to Haiti.

Nigeria has a better developed infrastructure in agricultural development and research and an ongoing program in soybean breeding. The number of trained workers is limited, however,

and this would put some constraints on the rate of development until the trained manpower deficits are overcome. The same remarks will apply to Tanzania, but there the "kibbutz-like" farms being developed offer an interesting means of affecting the introduction and utilization of soybeans.

II. PROJECT DESIGN AND ASSESSMENT OF LIMITING OR POSITIVE FACTORS

- A. The development of soybean production in any of the target countries would be undertaken in three phases.

First - the three suggested target countries, and others that may be deemed suitable, would be evaluated by a multidisciplinary team who would then select the country for initial implementation. The team would include support in agronomy, economics, food technology, nutrition, sociology, and cultural anthropology. The team would develop the criteria for evaluation and would develop their study out of an on-the-site visit of 4 to 6 weeks duration to each of the target countries.

Second - a demonstration, or pilot, project, the details of which would be developed by the assessment team, would be undertaken in a specific and limited area of the selected country for the purpose of demonstrating production and utilization of soybeans to a significant, but manageable number of small farmers, or farm villages, and to develop techniques and train personnel to undertake an expanded development program as well as to uncover unexpected or hidden problems that would require solving before further expansion of soybean production could be undertaken.

Third - depending on the results of the demonstration project, an expanded program involving a larger area and a greater number of farmers and villages would be undertaken. This would be essentially a country operated program, with AID input limited to technical advisors, consultants and to training.

The second and third phases would be planned around an integrated, systematic and coordinated program which would encompass seven elements. While the extent of the effort expended on these areas during the demonstration phase would be smaller than during the third phase, the level of effort would still be sufficient to develop the system to a viable level and to provide the necessary training and experience for expanding the program. The seven critical elements are:

1. **Adaptive research** - Initially to screen and select available commercial soybean varieties to select those best suited to local conditions and the simultaneous development of a package of cultural practices suitable for the physical and socioeconomic condition in the selected country. For the longer term, attention would be given to developing, through breeding, varieties with specific resistance to prevalent local disease, insect and nematode attack and increased efficiency under existing farm, soil and water conditions.

The research elements would tie in closely with extension, training, and production activities with feedback from the latter three to provide close guidance for the thrust of research efforts.

2. **Production development** - Initially, to demonstrate soybean production to target farm groups, then to aid individual farmers in using the crop in their farming systems. Extension service personnel would carry out most of the work so there would be close ties with the training of extension workers and the organization of an extension system, as well as with the research element.
3. **Utilization** - To show the individual farm family how to use the soybean directly for food and feed purposes, to assist in creating market demand by instructing prospective consumers in the direct use of soybeans as food, and to encourage small scale plants for the production of full fat soy flour for fortification of food and feed. This function would be carried out by the extension service with close ties to the production and research elements and, most importantly, to the marketing element of the project.
4. **Extension/education/communication** - This important element will concentrate on recruiting and training the professional and technical personnel required by all other elements and in developing the communication media that will be required, particularly by the production, utilization and marketing elements, to acquaint farmers and consumers on soybean production and utilization and to create basic interest in such production.
5. **Marketing** - The term is used here in its broad sense, encompassing all factors involved in bringing the soybean from the farmer to the ultimate consumer. It includes developing price and incentive policies to encourage farmers to adopt the crop, the development of collection, distribution, processing and selling channels, the provision of credit and the development of institutions and management

expertise to maintain and improve the facilities created. This function would tie in closely with all other elements, but particularly to the production and utilization elements.

6. Seed technology and production - The availability of ample quantities of seed of assured quality, purity, and viability is an essential input in a soybean development program. This activity might initially be a function of the research element but should be developed as a separate element, with close ties to research, production, and marketing, as soon as staff can be trained.
 7. Management - Since this is an integrated and systematic development, it is essential that the second and third phases of the project have a strong overall management component, including programming, budgeting, operational, and evaluation functions, so that activities are coordinated and feedback from the various elements in both the private and public sectors is obtained on a continuous basis to enable proper assessments of progress and necessary changes in plans or emphasis can be made.
- B. Limiting and Positive Factors. The main limiting factor in developing the project will most probably be limitations of trained manpower to undertake the many facets of the program. This will require a heavy emphasis on training, at all levels, particularly during the second phase of the program.
- C. Who will benefit? The incidence of benefits are almost ideal. Producers will obviously benefit. Since it is a new crop, there is not likely to be any group that will suffer adverse effects from the introduction. By increasing food supplies, consumers will benefit. Haiti also stands to benefit from a strengthening of her agricultural institutions which can, in turn, tackle other problems.

Consumers will benefit from the availability of soybeans as an extra food crop and as a valuable feed for their food animals. The availability of full-fat soy flour could mean that as much as 12% could be incorporated into the flour for bread baking purposes with consequent improvement in the nutritive value of the loaf and substantial saving in foreign exchange for the imported wheat. The development of small scale processing plants would provide employment opportunities

and increase the market for the farmer. Large farmers, to the extent they exist would also benefit but the small farmer is the target group.

Since soybeans are a new crop to all target countries except Nigeria, pricing and marketing policies can be developed without consideration of existing marketing and consumption patterns. It is difficult to visualize any possible tension developing between farmers and consumers.

- H. Inputs - The most important long term input will be proper soil and water management, including drainage and irrigation. The soybean needs adequate moisture to produce good yields. Mineral fertilizer, particularly phosphates and possibly lime may be needed, depending on the soil conditions. Until appropriate rhizobia are firmly established in the soil, all soybeans planted will have to be effectively inoculated with specific Rhizobium. The selection of the best type of rhizobia inoculant would be a part of the cultural package developed by the research element of the project. It may also be necessary to provide chemical pesticides, at least until disease and insect resistant varieties are developed. Mechanization, except for possibly encouraging animal-drawn plows, seeders, and cultivators is not a factor.

III. CRITICAL INTERVENTION POINTS

Two intervention points will be crucial to the success of this project. Training of personnel, at all levels will be an essential element, as will be the creation of an integrated and effective marketing policy and organization, using the term in its broad connotation as discussed earlier.

ENVIRONMENTAL THRESHOLD DETERMINATION

TO: DAA/FN/DS, Tony Babb
THRU: DS/PO, Robert Simpson
FROM: DS/AGR, Dean F. Peterson
SUBJECT: Environmental Threshold Determination

MAR 1 1979

8p

Project Title : Development of Improved Varieties of Soybeans
Project No. : 931-0560A
Specific Activity : Research Project
Reference : Initial Environmental/Examination (IEE) contained in the Project Statement/Paper dated 11/15/78 (See page 19 attached).

On the basis of the Initial Environmental Examination (IEE) referenced above and attached to this memorandum, I recommend that you make the following determination:

- XX 1. The proposed agency action is not a major federal action which will have a significant effect on the human environment.
- _____ 2. The proposed agency action is a major federal action which will have a significant effect on the human environment, and:
 - _____ a. An Environmental Assessment is required; or
 - _____ b. An Environmental Impact Statement is required.

The cost of and schedule for this requirement is fully described in the referenced document.

- _____ 3. Our environmental examination is not complete. We will submit the analysis no later than _____ with our recommendation for an environmental threshold decision.

Approved: Tony Babb
Disapproved: _____
Date : 3/1/79

Clearances:

DS/AGR/FCP:JYohe JYohe
DS/AGR:Mozynski Mozynski
DS/PO:RRogers RRogers
DS/PO:MRehcigl MRehcigl
DS/AGR:DFPeterson DFPeterson

2/21/79

DS/AGR/FCP:JMYohe/cl

facilities at the two institutions are adequate to conduct the required research and are improving. A recently completed addition to the plant sciences building on the University of Illinois campus provides excellent laboratory facilities for the plant pathology group and more closely integrates the Departments of Agronomy and Plant Pathology, now located in the single facility. The facilities development program, now known as the Food Production and Research Program, a multimillion dollar effort to upgrade and expand the research plant facilities of the University at several locations, continues with good support from the agricultural community and the legislature. The existing facilities, e.g., research farms, laboratories, specialized equipment, and the University library, remain at the disposal of the program. A heightened awareness on the campus to involve the agricultural sciences and the social sciences more closely and the development of a nutritional sciences division within the College of Agriculture, drawing on personnel from social sciences, medical sciences, and basic sciences to collaborate with nutritionists in the College of Agriculture's Departments of Animal Science, Dairy Science, and Food Science and with staff from the School of Human Resources and Family Studies will bring new dimensions to the program. This combination of management and facilities resources for research and educational programs and development of outreach capacity cannot be matched anywhere.

Key Personnel.

The key person to be identified in any contract emanating from this proposal is Dr. W. N. Thompson, Associate Dean, College of Agriculture, Director, Office of International Agriculture, and Director, International Soybean Program, INTSOY. Dr. Thompson was identified as the key person under research contract AID/TA/C-1294. A copy of his vita is included in Appendix A.

An outstanding professional staff will conduct the work described in previous sections. They include W. H. Judy, Associate Professor of Agronomy; J. A. Jackobs, Professor of Crop Production; R. M. Goodman, Assistant Professor of Plant Pathology; J. B. Sinclair, Professor of Plant Pathology; M. E. Irwin, Assistant Professor of Agricultural Entomology; L. S. Wei, Professor, Food Science; Quyen Nguyen, Assistant Professor of Agronomy; R. Stewart Smith, Assistant Professor of Agronomy; Earl Kellogg, Associate Professor of Agricultural Economics and Frederick Fliegel, Professor of Rural Sociology. Copies of their vitae are included in Appendix A.

Environmental Considerations.

Environmental aspects of the International Soybean Program INTSOY have been previously considered by the Agency. The soybean has potential to become one of the world's most important crops. It is high in energy due to high oil and protein content, yet fixes its own nitrogen. This project contributes to the development of improved varieties adapted to tropical conditions in family farming operations which could substantially improve the diets of LDCs without increasing requirements for nitrogen fertilization. This project contributes to the development of model insect, weed and disease management programs which will reduce the need for chemical control measures and will develop varieties which are resistant to major diseases and less susceptible to insect damage.

There is nothing foreseen from the outputs of this project which would adversely affect people, animals, land or the environment in general. Growing more soybeans

on small farms in LDCs will increase the annual output of high quality food per unit of energy input and, with new varieties more resistant to diseases and insects, there will be a decrease in the use of pesticides.

Therefore, typically of crop improvement research projects financed by A.I.D., there are no environmental problems expected from the proposed renewal of this research project nor from adoption of the improved materials

L. Women in Development.

It is the goal of the INTSOY program to encourage the widest possible participation of soybean workers, broadly defined, in the design and implementation of problem solving projects in soybean production, protection, marketing, and use. The current research contract AID/TA/C-1294 employs women professionals in the Departments of Agronomy, Plant Pathology, and Entomology actively supporting the research work. A continuation of these strategies under this proposed research project is assumed. Overall program requirements to advance knowledge in human nutrition in the development of soybean foods adapted to specific cultures and their acceptance in LDC diets hold great promise for the increased utilization of women in those areas where they have traditionally played a major contributing role.

The University of Illinois has an aggressive affirmative action program to assure opportunities of employment for qualified personnel, including minorities and females, in compliance with Title IX. Each campus in the University of Illinois system has an officer responsible for program implementation under coordination of a general officer of the University. The program is on file with a number of departments of the United States government.

IMPACT IDENTIFICATION AND EVALUATION FORM

Impact
Identification
and
Evaluation 2/

Impact Areas and Sub-areas 1/

A. LAND USE

1. Changing the character of the land through:

a. Increasing the population ----- N

b. Extracting natural resources ----- N

c. Land clearing ----- N

d. Changing soil character ----- N

2. Altering natural defenses ----- N

3. Foreclosing important uses ----- N

4. Jeopardizing man or his works ----- N

5. Other factors

B. WATER QUALITY

1. Physical state of water ----- N

2. Chemical and biological states ----- N

3. Ecological balance ----- N

4. Other factors

1/ See Explanatory Notes for this form.

2/ Use the following symbols: N - No environmental impact
L - Little environmental impact
M - Moderate environmental impact
H - High environmental impact
U - Unknown environmental impact

C. ATMOSPHERIC

- 1. Air additives ----- N
- 2. Air pollution ----- N
- 3. Noise pollution ----- N
- 4. Other factors

D. NATURAL RESOURCES

- 1. Diversion, altered use of water ----- N
- 2. Irreversible, inefficient commitments ----- N
- 3. Other factors

E. CULTURAL

- 1. Altering physical symbols ----- N
- 2. Dilution of cultural traditions ----- N
- 3. Other factors

F. SOCIOECONOMIC

- 1. Changes in economic/employment patterns ----- N
- 2. Changes in population ----- N
- 3. Changes in cultural patterns ----- N
- 4. Other factors

G. HEALTH

- 1. Changing a natural environment _____ N
- 2. Eliminating an ecosystem element _____ N
- 3. Other factors _____
- _____
- _____

H. GENERAL

- 1. International impacts _____ N
- 2. Controversial impacts _____ N
- 3. Larger program impacts _____ N
- 4. Other factors _____
- _____
- _____

I. OTHER POSSIBLE IMPACTS (not listed above)

See attached Discussion of Impacts.

ENVIRONMENTAL THRESHOLD DETERMINATION

MAR 1 1979

TO: DAA/FN/DS, Tony Babb
THRU: DS/PO, Robert Simpson ^{4 m for}
FROM: DS/AGR, Dean F. Peterson *Dean F. Peterson*
SUBJECT: Environmental Threshold Determination

Project Title: Weed Control Systems in LDCs
Project No.: 931-0463.11
Specific Activity: Research Project
Reference: Initial Environmental/Examination (IEE) contained in the Project Statement/Paper dated 12/01/78 (see page 16 attached).

On the basis of the Initial Environmental Examination (IEE) referenced above and attached to this memorandum, I recommend that you make the following determination:

- XX 1. The proposed agency action is not a major Federal action which will have a significant effect on the human environment.
- _____ 2. The proposed agency action is a major Federal action which will have a significant effect on the human environment, and:
 - _____ a. An Environmental Assessment is required; or
 - _____ b. An Environmental Impact Statement is required.

The cost of and schedule for this requirement is fully described in the referenced document.

- _____ 3. Our environmental examination is not complete. We will submit the analysis no later than _____ with our recommendation for an environmental threshold decision.

Approved: *T. Babb*

Disapproved: _____

Date: 3/1/79

Clearances:
DS/AGR/FCP: GWarren *G. F. Warren*
DS/AGR/FCP: KMBergo *KMB*
DS/AGR: MZozynski *MZ*
DS/PO: RRogers *RR*
DS/PO: MRchcigl *MR*

process.

In summary the administrative functions of the project are extensive and complicated. It requires not only the intent and resources but experience expertise, reputation and international contacts to be able to provide the services on which AID and LDCs have come to depend.

E. Environmental Impact

Initial Environmental Examination - the activities of this project fall into the area described in Environmental procedure regulations, Para. 216.2. (c) "Analyses, Studies, Academic or Investigative Research, Workshops and Meetings". These classes of activities will not normally require the filing of an Environmental Impact Statement or the preparation of an Environmental Assessment. It is possible that an output of this project will be a set of procedures, guidelines or research results which when used would require such an assessment. However, the project itself only proposes research and directly supportive activities. Under these guidelines this activity clearly qualified for a negative determination at the time when a threshold decision is determined.

IV. Financial Plan

This proposal requests AID funding to extend the project an additional three years to:

1. Perfect new technology which both controls severe tropical weed growth and provides a weed residue mulch that continues to suppress weed while providing a superior cultural medium.
2. Continue research on the most serious tropical weed problems for which only marginal control has so far been developed.
3. Develop improved herbicide application equipment.
4. Study socio-economic consequences of various weed control systems as pertains to small farmers and rural poor.
5. Continue the development of superior, environmentally sound, socially acceptable, weed control systems for small farmers.

As discussed in the Economic Feasibility section IVA the potential return on the proposed research far exceeds costs. Host country contributions of staff, land, facilities and equipment exceed 25% of the cost of the project activity in their respective countries.

Following is a statement of annual costs and FY obligations:

<u>Year</u>	<u>Required Amounts</u>	<u>Obligations</u>
April 1, 1979-Mar. 31, 1980	\$306,315	FY (000) FY 79-325
April 1, 1980-Mar. 31, 1981	310,527	FY 80-200
April 1, 1981-Mar. 31, 1982	361,759	FY 81-454
<u>3 Year Total</u>	<u>\$978,601</u>	<u>979</u>

A detailed budget is provided in Annex A.

INTERNATIONAL SOYBEAN PROGRAM - INTSOY
University of Illinois - University of Puerto Rico
(Urbana-Champaign) (Mayaguez)

AID Contract AID/CM/ta-c-73-19
Plan of Work, July 1, 1974 to March 31, 1975

The University of Illinois College of Agriculture International Soybean Program INTSOY contracted with the U. S. Agency for International Development to conduct international soybean research and research-related activities under the provisions of Contract No. AID/CM/ta-c-73-19. The Contract period is from April 1, 1973 to March 31, 1976. Work under the Contract is proceeding according to plans for FY 1974. The following is the Plan of Work and Budget for July 1, 1974 to March 31, 1975 (nine months).

I. Staff and Administration

Staff additions will include personnel in professional and nonprofessional positions. The following professional staff will be recruited and placed during FY75:

1. Associate Director and Senior Agronomist (to be located on the University of Puerto Rico - Mayaguez campus) July 1, 1974, .25 FTE.
2. Entomologist--Pest Management, July 1, 1974, 1.0 FTE.
3. Food Science--Processing, July 1, 1974, .25 FTE.
4. Plant Pathologist--Fungal and Bacterial, July 1, 1974, .25 FTE.
5. Plant Pathologist--Virology, July 1, 1974, .75 FTE.

The following nonprofessional staff will be added to the program:

1. Research Assistant--Data Processing, July 1, 1974, 1.0 FTE.
2. Technician--Processing Equipment, July 1, 1974, 1.0 FTE.
3. Research Associate--Soybean Pathology, July 1, 1974, .5 FTE.
4. Secretarial assistance--Administration and Agronomy, July 1, 1974, 1.5 FTE.

The addition of the Associate Director, to be located at the University of Puerto Rico - Mayaguez campus, will strengthen program coordination in planning, administration and operation. To accommodate this addition to the program staff the University of Illinois has obligated funds to pay half the salary of the INTSOY Program Director, Dr. W. N. Thompson, and only half his salary will be charged to this research contract. It should be emphasized, however, that the International Soybean Program is the sole assignment of Dr. Thompson and he will devote 100 percent time to the administration of the integrated international soybean work. The administrative organization, revised during FY74, will continue to seek better coordination of research efforts among the departments and institutions involved and will broaden planning efforts for further research and utilization of research results.

The Entomologist-Pest Management is to be added to provide field research orientation to the entomology program, without increase in the entomology FTE's. The entomology technician, who was responsible for initiating the reference collection of scientific literature on insects of soybeans, will not be retained. The part of that work directly related to INTSOY will be maintained by the continuing soybean faunal analyst.

The time of the continuing Food Scientist-Chemistry will be reduced from full time to three-quarter time to permit addition of the Food Scientist-Processing, on a quarter-time basis, to strengthen research on improved soy foods to have application of LDC's. Special attention will be given to development of simply prepared soybean "milks" for home and village use.

The new position in plant pathology will be divided between two scientists who will conduct research on diseases affecting soybeans in tropical and subtropical areas. This combination of scientific expertise will allow coverage of the major viral, bacterial, and fungal diseases. A supporting research associate is added.

Clerical and typing assistance is added in administration and in support of the plant breeding work.

II. Soybean Variety Development

The major objectives of variety development are high yield and high protein per unit of land area, suitable photo-period response, resistance to limiting diseases and insect pests, and wide adaptability in tropical and subtropical environments.

The standard variety experiment program, initiated in early 1973, is a necessary and integral part of the INTSOY plan for soybean varietal development. This program provides an evaluation of existing germplasm under differing environments. At the same time, researchers in cooperating countries learn whether introduced varieties can be grown and whether a full-scale plant breeding program should have high priority. The superior performance of some U.S. varieties under tropical and subtropical conditions, as shown by preliminary results of the first year's work under this contract, show that the priority given to the standard variety experiment program is a sound approach.

Work in soybean variety development for the year beginning July 1, 1974 will include the following:

1. Completion of evaluation of results of the first year (1973) plantings under the standard variety experiment program that included 20 varieties and, in some cases, local varieties. The analysis will include comparisons of yield, oil and protein content, length of maturity, plant height, lodging, shattering and seed weight. A publication reporting on the variety experiments beginning in April 1973 and continuing into FY74 will be completed. Data for each experiment will be summarized and distributed to cooperating scientists.

2. Standard variety experiments in different agroclimatic regions will be conducted to further evaluate varieties showing promise in previous experiments and to test promising new varieties. The 1973 experiments that included 20 varieties will be modified on the basis of experience gained to date. The new experiments will have 15 varieties--12 of the best-performing varieties in previous experiments, and 3 new varieties. Cooperating scientists will be asked to include two local varieties at each location, i.e., varieties that show potential for yield, resistance to disease and insect pests, or that provide other desirable characteristics useful to the breeding program. Approximately 40 countries will be involved in the varietal experiment program during FY75, some of which will have more than one varietal experiment in order to evaluate results during the dry and rainy seasonal periods in the different environmental areas of the countries.
3. Seeds from promising local varieties in the standard variety experiments will be collected for use in future varietal experiments. Seed will be increased in Puerto Rico as part of the interinstitutional collaborative program.
4. Plant selections showing promising characteristics for tropical and subtropical environments will be incorporated into a crossing program in Puerto Rico in cooperation with the 211(d) activities of the University of Illinois and the University of Puerto Rico. Yield potential, plant height, short-day intensitivity, shattering resistance, pod height, insect resistance and disease resistance are characteristics which will be considered in the crossing program. Germplasm will be collected from existing breeding programs throughout the world.

5. Germplasm having favorable agronomic characteristics will be evaluated for oil and protein quantity and for quality as deemed necessary and advisable.
5. An addition to the varietal experiment program of FY74 is a program developed by the agricultural entomology group designed to provide data for selected experiments on insect pests attacking soybean plants. Leaf damage will be observed in the field at three different stages of the growing cycle. Insects will be swept from plots and evaluated for potential plant and yield damage.

III. Taxonomic Information Retrieval System (TAXIR)

Limited support, in the form of a research assistant-data processing (who will also support the production agronomist and plant breeder) and allocation of computer time, will be provided to TAXIR to enable information derived from the varietal experiment program and breeding program to be integrated into the system. This system codes germplasm information published in USDA/ARS Regional Soybean Laboratory manuals on punchcards for quick retrieval. A major part of support for the TAXIR system is derived from other sources.

IV. Insect Control and Entomological Studies

The Entomologist-Pest Management, to be added at the beginning of the fiscal year, will add an adaptive field research orientation to the entomology program. Emphasis will be placed on identification of soybean insect problems and means of control under varying tropical and subtropical conditions.

Agricultural entomology has prepared a pest management guideline for Illinois using a method which, it is believed, can be applied to other regions. A pilot study will be undertaken in Puerto Rico to test this hypothesis which, if successful, will enable the method to be undertaken in tropical or subtropical countries or regions as a utilization benefit from the research contract. The pilot study will be undertaken and completed during FY75.

The reference collection of soybean anthropods, partially supported by INTSOY, which includes pests, predators, and parasites, will continue to be expanded. In FY74 the insect collection doubled and now contains approximately 60,000 specimens representing 1,300 species, plus biodata from 20 foreign countries and all soybean-producing states in the U.S. Information on the collection is computerized to permit rapid retrieval of phenological, zoogeographical and population characteristics of insects and mites associated with soybeans.

The reference collection of scientific literature on insects of soybeans will be kept up to date making it possible to provide computer printouts in response to requests received from soybean researchers worldwide. This will be done under supervision of the Soybean Faunal Analyst now that the reference collection is well developed and INTSOY support of the entomology library technician is to be discontinued. The Soybean Insect Research and Information Center (SIRIC) increased its listings by 6,800 in FY74 and currently contains over 11,500 titles and abstracts covering the literature of insects associated with soybeans and insect vectors of diseases of soybeans.

V. Soybean Pathology

Work will be initiated in soybean pathology research with the addition of two scientists (one FTE). This combination of expertise gives coverage to viral, fungal, and bacterial diseases with emphasis being placed on virus diseases, which appear to be the most important ones affecting soybeans in tropical and subtropical areas. Work in soybean pathology under this contract will be closely coordinated with work in plant breeding, agronomy, and entomology with emphasis on developing disease and insect resistant varieties. University of Illinois personnel will work with University of Puerto Rico scientists associated with their AID 211(d) grant (Soybean and other Food Legume Pathology and Entomology) and Illinois 211(d) grant (Soybean Breeding) research workers.

The following work will be initiated in FY75.

1. Assemble information on major limiting soybean diseases in cooperating areas.
2. Prepare a compendium of soybean diseases.
3. Screen soybean varieties and germplasm collections for reaction to white-fly transmitted viral diseases in collaboration with the University of Puerto Rico.
4. Observe differential reactions to other soybean diseases in field trials in Puerto Rico and other locations.
5. Undertake a coordinated program for selection of virus disease resistance in conjunction with plant breeding activities being conducted under the AID research contract and AID 211(d) grants.

VI. Food Science Nutrition

In the area of food science and nutrition, the following activities will be carried out within the framework of this research contract:

1. Product development. During FY75 work will continue on the development of prototype foods to have application in LDC's. Feasibility of preparing simple soybean "milks" on a home or a village industry scale will be investigated. If feasibility is established, plans will be made for further development in succeeding years of the contract.
2. Further nutritional evaluation of selected soybean products. PER's and amino acid analyses were determined on three soybean food products developed by the University which, on the basis of appearance and taste, showed promise for human food use. However, two of these products were lower in nutritional quality (PER) than would be expected. Thus, confirmation of these results are needed and, if required, further processing studies to improve the PER's will be carried out. Nutritional evaluation will be made on other products which have not been evaluated to date.

3. Varietal effects of rehydration and cooking qualities. An investigation of the effect of variety on soybean rehydration and cooking quality will be conducted if preliminary experiments conducted during early 1974 indicate that varietal effects are significant. The objective will be to find varieties which are most suitable for home cooking and to obtain information which will be useful to soybean procedures, breeders and geneticists who may wish to produce (or breed for) soybean varieties suitable for direct consumption as cooked beans.

Studies on methods of tenderizing soybeans will be continued.

VII. Training, Workshop and Communications

Training of foreign country research workers, principally by demonstration, in the several subject-matter areas will be conducted by INTSOY scientists during site visits to cooperating institutions.

A major research workshop will be held in Ethiopia in October 1974 for soybean workers of Africa, the Near East and South Asia. This workshop will deal with various aspects of the soybean production, protection and utilization, much as the workshop held in Puerto Rico in FY74; however, increased emphasis will be placed on utilization. It is anticipated that GT3 funds will be available to support the workshop as well as funds from countries and organizations jointly sponsoring this activity.

During the year, plans will be made for cooperating scientists to participate in the World Soybean Research Conference to be held at the University of Illinois, August 3-8, 1975.

Under a cooperative, and separately funded, AID-USDA training program, two short courses will be developed for soybean scientists from LDC's and offered on the Urbana-Champaign campus. One course, of 6 weeks duration, will deal with soybean

processing for food uses and is scheduled to commence in March 1975. The second, of 20 weeks duration, deals with technical and economic aspects of soybean production. It will commence in May 1975.

The newsletter initiated in FY74 will be further developed and distributed to all individuals and centers interested and concerned with soybean production and utilization.

VIII. Travel

Requests by USAID, interested governments, and others were numerous during parts of FY74. With limited staff and budget, travel plans of the INTSOY scientists will be limited to locations that have sufficient interests, resources and potential for contributing to the INTSOY research program. The travel will be largely confined to locations conducting or chosen to conduct standard varietal experiments, to the international centers serving as relay and outreach stations for dissemination of research results, to centers of information on soybeans breeding, protection and development, and to selected international meetings pertinent to the research program. Requests for technical assistance activities involving travel will be financed by separate funding such as through task orders or other contractual arrangements.

IX. Budget

Operating Budget, July 1, 1974 to March 31, 1975

I. Salaries and Wages	\$124,785
II. Fringe	14,365
III. Indirect Costs	89,000
IV. Travel and Transportation	31,350
V. Other Direct Costs	16,500
VI. Equipment, Materials and Supplies	<u>24,000</u>
Total	\$300,000

Attachment A

Time-Phased Operational Schedule

July 1, 1974 to March 31, 1975

Activity	Quarters		
	I	II	III
1. Staffing	• • • • •	• • • • •	• • • • •
2. Plant Breeding Activities	• • • • •	• • • • •	• • • • •
3. Taxonomic Information Retrieval (TAXIR)	• • • • •	• • • • •	• • • • •
4. Tropical Pest Management Program	• • • • •	• • • • •	• • • • •
5. SIRIC Literature Dissemination to Researchers	• • • • •	• • • • •	• • • • •
6. Expansion of Collection of Soybean Arthropods	• • • • •	• • • • •	• • • • •
7. Prepare Soybean Disease Compendium	• • • • •	• • • • •	• • • • •
8. Map Limiting Soybean Diseases	• • • • •	• • • • •	• • • • •
9. Screen Varieties for Disease Resistance		• • • • •	• • • • •
10. Development of Simple Procedures for Home Preparation of Soy Foods	• • • • •	• • • • •	• • • • •
11. Nutritional Evaluation of Selected Soybean Products	• • • • •	• • • • •	• • • • •
12. Varietal Effects on Rehydration and Cooking of Varieties	• • • • •	• • • • •	• • • • •
13. Workshop			
a. Planning and Organization	• • • • •		
b. Workshop and Proceedings		• • • • •	
14. Newsletter	• • •	• • •	• • •
15. Short Course			
a. Processing for Food Uses			• • •
b. Technical and Economic Aspects of Production (begins May 1975)			• • •

Budget Contract C-73-19, July 1, 1974 to March 31, 1975

	Name	Annual FTE	Line allocation	Subtotal	Total
I. SALARIES AND WAGES					
A. Professional Staff					\$124,785
		(5.5)		\$78,755	
1a.	Project Director				
	Thompson	.5	\$10,970		
b.	Associate Director and Senior Agronomist				
	Abrams	.25	3,750		
c.	Assistant Director--Operations				
	McCowen	.25	3,940		
2a.	Production Agronomist				
	Whigham	.75	9,750		
b.	Plant Breeder				
	Hittle	.25	4,895		
3a.	Food Science--Chemistry				
	Ferrier	.75	9,000		
b.	Food Science--Processing				
	Nelson	.25	6,130		
4.	Entomology--Pest Management				
	Vacant	1.0	11,250		
5.	Entomology--Soybean Faunal Analyst				
	Godfrey	.5	5,625		
6a.	Plant Pathology--Fungal, Bacterial				
	Sinclair	.25	5,005		
b.	Plant Pathology--Virology				
	Vacant	.75	8,440		
B. Nonprofessional					
		(6.0)		46,030	
1.	Research Assistant--Field Trials				
	Dunker	1.0	6,600		
2.	Research Assistant--Data Processing				
	Vacant	1.0	7,650		
3.	Technician--Soybean Cooking Qualities				
	Rosborough	1.0	6,225		
4.	Technician--Processing Equipment				
	Vacant	1.0	6,055		
5.	Research Associate--Soybean Pathology				
	Vacant	.5	4,500		
6.	Clerk-typist--Administration				
	Spencer	1.0	6,000		
7.	Clerk-typist--Agronomy				
	Vacant	.5	3,000		
8.	Hourly wages				
	4,000 hrs.		6,000		
II. FRINGE BENEFITS					
A. Retirement 11.61% of 114,285					14,365
B. W.C. & Med. Ins. 1.7% of 124,785					12,235
				2,130	
III. INDIRECT COSTS					
A. On campus--72% of 124,785					89,000
				89,000	
IV. TRAVEL AND TRANSPORT					
A. U.S. Travel					31,350
				5,250	
1.	Washington and other				
			1,875		
2.	Puerto Rico--15 RT @ \$300				
			3,375		
B. International--11 RT @ \$1,500					13,500
C. Per Dien					12,600
1.	U.S. and P.R.--6 mos. @ \$1,200				
			5,400		
2.	International--10 mos. @ \$900				
			7,200		

Budget Contract C-73-19, July 1, 1974 to March 31, 1975 (cont.)

Name	Annual FTE	Line allocation	Subtotal	Total
V. OTHER DIRECT COSTS				
A. Computer Time				\$ 16,500
B. Telecom, Xerox, OEC			\$ 3,750	
C. Publications			3,750	
D. Nurseries in P.R.			4,500	
			4,500	
VI. EQUIPMENT, MATERIALS AND SUPPLIES				
A. Seed, inoculum and freight				\$ 24,000
B. Nutritional Analyses			9,000	
C. Expendable Supplies			5,250	
D. Manufacture of simple equipment for soybean foods			7,500	
			2,250	
TOTAL				\$300,000

International Soybean Program - INTSOY
University of Illinois - University of Puerto Rico
(Urbana-Champaign) (Mayaguez)

AID Contract AID/CM/ta-c-73-19
Plan of Work, Fiscal Year 1975

The University of Illinois College of Agriculture International Soybean Program INTSOY contracted with the U. S. Agency for International Development to conduct international soybean research and research-related activities under the provisions of Contract No. AID/CM/ta-c-73-19. The Contract period is from April 1, 1973 to March 31, 1976. Work under the Contract is proceeding according to plans for FY1974. The following is the Plan of Work and Budget for FY1975.

I. Staff and Administration

Staff additions will include personnel in professional and non-professional positions. The following professional staff will be recruited and placed during FY75:

- 1. Associate Director (to be located on the University of Puerto Rico-Mayaguez campus) July 1, 1974, .25 FTE.
- 2. Entomologist-Pest Management - July 1, 1974, 1.0 FTE.

The following nonprofessional staff will be added to the program:

- 1. Technician-Agronomy - July 1, 1974, 1.0 FTE.
- 2. Technician-Food Science - July 1, 1974, 1.0 FTE.
- 3. Research Assistants-Food Science - September 1, 1974, 1.0 FTE.
- 4. Secretary - July 1, 1974, 3.0 FTE.

The addition of the Associate Director, to be located at the University of Puerto Rico-Mayaguez campus, will strengthen program coordination in planning, administration and operation. To accommodate this addition to the program staff the University of Illinois has obligated funds to pay half the salary of the INTSOY Program Director, Dr. W. N. Thompson, and only

half his salary will be charged to the research contract. It should be emphasized however, that the international soybean program is the sole assignment of Dr. Thompson and he will devote 100 percent time to the administration of the integrated international soybean work. The administrative organization, revised during FY74, will continue to seek better coordination of research efforts among the departments and institutions involved and will broaden planning efforts for further research and utilization of research results.

The Entomologist-Pest Management is to be added to provide field research orientation to the entomology program, without increase in the entomology FTE's. The entomology technician, who was responsible for initiating the reference collection of scientific literature on insects of soybeans, will not be retained. The part of that work directly related to INTSOY will be maintained by a continuing entomology taxonomist. In anticipation of the availability of funds under a utilization contract, the percentage of time of professional appointments in food science is being reduced in FY75 from 1.0 to .75. Support personnel is added.

II. INTSOY Varietal Experiment Program

Standard experiments in different agroclimatic regions will be continued to further evaluate varieties showing promise in previous experiments and to test promising new varieties. Included at each location will be local varieties that show potential for increased yields, increased resistance to disease or insect pests, or that provide other desirable characteristics useful to the breeding program. An addition to the varietal experiment program of FY74 is a program developed by the agricultural entomology group designed to provide data on insect pests attacking soybean plants. Leaf damage will be observed in the field at three different stages

of the growing cycle. Insects will be swept from the plants and returned to the Illinois campus for evaluation of potential plant and yield damage.

Approximately thirty countries will be involved in the varietal experiment program during FY75, some of which will have more than one varietal experiment in order to evaluate results during the dry and rainy seasonal periods in the different environmental areas of the countries.

Arrangements are being made to include seed of promising varieties in later INTSOY varietal experiments. Subject to establishment of an appropriate arrangement, the seed will be increased in Puerto Rico as part of the interinstitutional collaborative program.

A publication reporting on the variety experiments conducted during FY74 will be completed by June 1975. Data for each experiment will be summarized and distributed to cooperating scientists.

III. Plant Breeding Activities

Plant breeding activities under this contract will be complementary with activities carried out under the 211(d) program of the University of Illinois and the University of Puerto Rico-Mayaguez campus. Seed lots of germplasm strains showing promising characteristics for tropic and sub-tropic production will be sent to some of the locations conducting standard varietal experiments. As promising material is identified, cooperating country samples will be collected and forwarded to Puerto Rico for further observation and incorporation into breeding stock. Germplasm having favorable agronomic characteristics will be returned to the University of Illinois and tested for ease of cooking and nutritional quality.

The major objectives of the program continue to include high yield, suitable photo-period response, wide adaptability in tropical and sub-tropical environments, and resistance to limiting diseases and insect pests. Level of protein and oil will also be studied. Analyses will be performed at the Urbana-Champaign campus and at the University of Puerto Rico, College of Agricultural Sciences and Agricultural Experiment Station.

IV. Cultural Practice Research

Studies will continue in Puerto Rico at the Lajas and Isabelã experiment stations to determine the best package of cultural practices for soybeans under similar environmental conditions, including planting dates, fertilization, inoculation, planting density, insect, weed, and disease control. This work will be conducted on the most promising varieties from the standard varietal experiments and from breeding work. As data accumulate confirmatory studies will be carried out at other locations, including such international centers as show interest in participation. Soybean pathology research, to be funded from other sources, will be conducted in association with cultural practice research in Puerto Rico. This research will be planned and implemented with the work under the AID 211(d) work at Puerto Rico and Illinois.

V. Taxonomic Information Retrieval System (TAXIR)

Limited support, in the form of a technical programmer/operator and allocation of computer time, will be provided to TAXIR to enable information derived from the varietal experiment program and breeding program to be integrated into the system. This system codes germplasm information published in USDA/ARS Regional Soybean Laboratory manuals on punchcards for quick retrieval. A major part of support for the TAXIR system is derived from other sources.

VI. Insect Control and Entomological Studies

The Entomologist-Pest Management, to be added at the beginning of the fiscal year, will add an adaptive field research orientation to the entomology program. Emphasis will be placed on identification of soybean insect problems and means of control under varying tropical and sub-tropical conditions.

Agricultural entomology has prepared a pest management guideline for Illinois using a method which, it is believed, can be applied to other regions. A pilot study will be undertaken in Puerto Rico to test this hypothesis which, if successful, will enable the method to be undertaken in tropical or sub-tropical countries or regions as a utilization benefit from the research contract. The pilot study will be undertaken and completed during FY75.

The reference collection of soybean arthropods, partially supported by INTSOY, which includes pests, predators, and parasites, will continue to be expanded. In FY74 the insect collection doubled and now contains approximately 60,000 specimens representing 1,300 species, plus biodata from 20 foreign countries and all soybean producing states in the U. S. Information on the collection is computerized to permit rapid retrieval of phenological, zoogeographical and population characteristics of insects and mites associated with soybeans.

Continuing efforts will be made to keep the reference collection of scientific literature on insects of soybeans up-to-date and to provide computer printouts on requests received from soybean researchers worldwide. This will be done under supervision of the Entomologist/Taxonomist now that the reference collection is well developed and INTSOY support of the entomology library technician is to be discontinued. The Soybean Insect Research and

Information Center (SIRIC) increased its listings by 6,800 in FY74 and currently contains over 11,500 titles and abstracts covering the literature of insects associated with soybeans and insect vectors of diseases of soybeans.

In FY74 a packet of selected papers providing general information on soybean entomology was developed and distributed in response to requests from individuals for an introduction to the literature in this expanding area. The packet, of looseleaf design to permit expansion, consisted of 25 articles covering the areas of soybean arthropods fauna, soybean pest management, applied soybean arthropod ecology and bibliographies. During FY75 the packet will be expanded and updated.

VII. Food Science and Nutrition

Utilization studies, formerly considered within the research contract, will be undertaken under a separate utilization contract. The following activities will be carried out within the framework of the research contract:

1. Product development

During FY75 work will continue on the development of new prototype foods to have application in LDCs. The major emphasis will be given to determine the feasibility of preparing simple soybean "milks" on a home or village industry scale. Assuming feasibility is established plans will then be made for development in succeeding years of the contract.

2. Further nutritional evaluation of selected soybean products

Certain of the products developed by the University which, on the basis of appearance and taste show promise for human food use,

to certain soy cereal blends which have promise for use in child-feeding formulas. These investigations will continue through FY75.

3. Nutritional evaluation of selected soybean varieties

Varieties which show promise for extensive use under tropical and sub-tropical conditions will be tested for protein content, protein quality as determined by PER and amino acid analysis, and for adaptability to various cooking and processing procedures developed by the University of Illinois.

VIII. Training Workshop and Communications

Training of foreign country nationals, principally by demonstration, in the several subject matter areas will be conducted by INTSOY scientists during site visits to cooperating institutions.

A major workshop will be held in the Near-East South Asia region or in Africa during FY75. This workshop will deal with various aspects of the production and utilization of soybeans, much as the workshop held in Puerto Rico in FY74. To the greatest extent possible the participants will come from the Near-East South Asia-African region. No monies are budgeted for this workshop under the research contract in anticipation of the availability of GTS funds.

During the year, plans will be made for cooperating scientists to participate in the International Soybean Conference to be held at the University of Illinois, August 3-8, 1975.

A newsletter to be initiated in FY74 will be further developed and distributed to all individuals and centers interested and concerned with soybean production and utilization. No funds are included in the research

contract budget for the development or distribution of this newsletter. It is anticipated that GTS funds will be made available for this purpose.

IX. Travel

Requests by USAID, interested governments, and others were numerous during parts of FY74. With limited staff and budget travel plans of the INTSOY scientists will concentrate on locations that appear to have sufficient interests, resources and potential for contributing to the INTSOY research program. The travel will be largely confined to locations conducting or chosen to conduct standard varietal experiments, to the international centers serving as relay and outreach stations for INTSOY, to centers of information on soybean breeding, protection and development, as well as international meetings pertinent to the research program. Requests for technical assistance involving travel will be financed by separate funding such as through task orders or other contractual arrangements.

X. Budget

Operating Budget FY75

I. Salaries and Wages	\$164,025
II. Fringe	20,255
III. Indirect Costs	103,335
IV. Travel and transportation	49,420
V. Other Direct Costs	26,000
VI. Equipment, Materials and Supplies	<u>39,000</u>
	\$402,035

Anticipated needs for first three quarters of FY75 are \$325,000.

Attachment A

Time Phased Operational Schedule

FY75

Activity	Quarters			
	I	II	III	IV
1. Staffing				
2. Standard Varietal Experiments				
3. Plant Breeding Activities				
4. Cultural Practice Research				
5. TAXIR				
6. Pest Management Program				
7. Literature Search for SIRIC				
8. Expansion of Collection of Soybean Arthropods				
9. Varietal Effects of Dehydration and Cooking				
10. Nutritional Assays on Prototype Foods				
11. Simplified Procedures for Home Preparation of Soy Foods				
12. Preparation of Simple Soy Milks				
13. Workshop				
a. <u>If</u> Nesa Region	_____			
b. <u>If</u> East Africa			_____	
14. Newsletter	_____	_____	_____	_____

Attachment B

Detailed Operating Budget FY75

I. Salaries & Wages			164,025
A. Professional		90,275	
1. Program Director	.5	14,600	
1a. Associate Director	.25	5,000	
1b. Asst. Director	.25	5,350	
2. Production Agronomist	1.0	19,375	
3. Food Scientist	1.75	16,150	
4. Entomologist/Pest. Mgt.	1.0	15,000	
5. Entomologist/Taxonomist	1.0 0.5	14,800	
B. Non-Professional		73,750	
1. Technician-Agronomy	2.0	19,000	
2. Technician-Food Science	2.0	16,350	
3. Secretary	3.0 1.5	22,000	
4. Grad. Asst.-Food Sci.	1.0	8,400	
5. Hourly Wages 4000 hrs.		8,000	
II. Fringe			20,255
1. Retirement 11.61 of 147,625		17,140	
2. Workmens Comp. and Med. Ins. 1.9 of 164,025		3,115	
III. Indirect Costs			103,335
A. On campus 63% of 164,025		103,335	
IV. Travel & Transportation			49,420
A. U. S. Travel		10,000	
1. Washington and other	2,500	2000	
2. Puerto Rico 25 RT @ 300	7,500	4500	
B. International 12 RT @ 1500 ea		18,000	15000
C. Per Diem		21,420	14,020
1. 10 mo. Puerto Rico @ 1170/mo	11,700	39,420	
2. 12 mo. Int. @ 810/mo.	9,720	15,000 24,420	
V. Other Direct Costs			26,000
A. Computer		5,000	
B. Telecom, Xerox, Ofc. Supplies		5,000	
C. Nurseries in Puerto Rico		11,000	- 6000.00
D. Publications		5,000	

Attachment B - con't.

VI. Equipment, Materials & Supplies		39,000
A. Seed, Inoculum & Freight	15,000	
B. Nutritional Analyses	10,000	
C. Expendable Supplies	10,000	
D. Manufacture and testing of simple equipment for soybean foods	4,000	
		<u>\$402,035</u>

AID 1350-1X (7-71)
PIO/T

DEPARTMENT OF STATE
AGENCY FOR
INTERNATIONAL DEVELOPMENT

PROJECT IMPLEMENTATION
ORDER/TECHNICAL
SERVICES

1. Cooperating Country
TA/BUREAU 316 7521
Page 1 of 4 Pages
2. PIO/T No.
73-17-13-560-23
3. Original or
Amendment No. _____
4. Project/Activity No. and Title Development or Improved
Varieties of Soybeans and Supporting Cultural
and Marketing Practices for Production in the
Tropics, and Information Delivery Systems 102

DISTRIBUTION

5. Appropriation Symbol
73-11X1023
6.A. Allotment Symbol and Charge
702-31-074-00-22-41
6.B. Funds Allotted to:
 A.I.D./W Mission
7. Obligation Status
 Administrative Reservation Implementing Document
8. Funding Period (Mo., Day, Yr.)
From 4/1/76 To 10/31/76
9.A. Services to Start (Mo., Day, Yr.)
Between 4/1/76 and ---
9.B. Completion date of Services
(Mo., Day, Yr.) 3/31/79
10.A. Type of Action
 A.I.D. Contract Cooperating
Country Contract Participating Agency
Service Agreement Other
10.B. Authorized Agent
AED/W

Estimated Financing		(1)	(2)	(3)	(4)
\$1,000=		Previous Total	Increase	Decrease	Total to Date
11. Maximum A.I.D. Financing	A. Dollars		405,000		405,000
	B. U.S.-Owned Local Currency				
12. Cooperating Country Contributions	A. Counterpart				
	B. Other				

FUNDS RESERVED BY
POSTED 2/1/76
SER/FM/GSD

13. Mission References

14. Instructions to Authorized Agent
This PIO/T authorizes the Contract Office to negotiate a 3 year contract with the University of Illinois, and provide incremental funding for a period of seven months, 4/1/76 to 10/31/76. Scope of Work of the project is given in Attachment #1. The total cost of the 3 year contract shall not exceed \$2,270,600 as recommended by PAC on January 16, 1976 and approved by the DA/AA.

15. Clearances - Show Office Symbol, Signature and Date for all Necessary Clearances.

A. The specifications in the scope of work are technically adequate TA/AGR, W. Garman, Date: 2/13/76	B. Funds for the services requested are available TA/W, I. Hornstein, Date: 2/13/76 TA/SES, M. Rechciol, Date: 2/13/76
C. The scope of work lies within the purview of the initiating and approved Agency Programs TA/AGR, G. Laird, Date: 2/13/76 TA/AGR, I. Hesser, Date: 2/13/76	D. TA/PPU/PPA, C. Molfetto, Date: 2/13/76
E. TA/AGR, K. Brundage, Date: 2/13/76	F. TA/PPU/PPA, A. Korvinski, Date: 2/13/76

16. For the cooperating country: The terms and conditions set forth herein are hereby agreed to
Signature and date: _____
Title: Chief, TA/PPU/PPA
Date of Signature: 2/13/76

TA/PPU/PPA, Mr. John Gunning

February 13, 1976

TA/AGR, Leon F. Hesser

PIO/T, Development of Improved Varieties of Soybean and Supporting Cultural and Marketing Practices for Production in the Tropics - University of Illinois - AID/ta-c-73-19

The attached PIO/T requests a new contract for the project with the University of Illinois for a three-year period.

The new research contract stipulates a phase-out of Objective No. 7 on soybean product development, as recommended by the RAC in its January 16, 1976 meeting. The remaining two recommendations by RAC are being met following discussions with the Contractor: nutritional qualities of new varieties and acceptability by consumers is specified in Objective No. 1; and the Contractor recognizes the urgency of assigning a microbiologist to the Rhizobia research activities.

The PIO/T provides only partial funding for the period, April 1, 1976 to October 31, 1976 to meet the contracting deadline. An amendment will be submitted to cover a State-of-the Art Report on Food Processing. This would be a comprehensive overview of the research findings to date, (Illinois and other researchers) as well as past and present experiences in LDCs on the utilization and acceptance of soybeans as human food.

A copy of the RAC recommendations, the PAR of 10/24/75 and the contract face sheet are attached.

Enclosures:
a/s

Clearances:
TA/AGR, W. Garman WHG Date 2/13/76
TA/AGR, K. Brundage KB Date 2/13/76
TA/N, I. Hornstein IHS Date 2/17/76

TA/AGR, JWhite:bw 2/13/76

AID 1350-1X
(7-71)

DEPARTMENT OF STATE
AGENCY FOR
INTERNATIONAL DEVELOPMENT

PIO/T

PROJECT IMPLEMENTATION
ORDER/TECHNICAL
SERVICES

1. Cooperating Country

TA/BUREAU

Page 1 of 4 Pages

2. PIO/T No.

3. Original or
Amendment No. _____

4. Project/Activity No. and Title Development of Improved Varieties of Soybeans and Supporting Cultural and Marketing Practices for Production in the Tropics, and Information Delivery Systems

DISTRIBUTION

5. Appropriation Symbol

6.A. Allotment Symbol and Charge

6.B. Funds Allotted to:

A.I.D./W Mission

7. Obligation Status

Administrative Reservation Implementing Document

8. Funding Period (Mo., Day, Yr.)

From 4/1/76 To 10/31/76

9.A. Services to Start (Mo., Day, Yr.)

Between 4/1/76 and --

9.B. Completion date of Services

(Mo., Day, Yr.) 3/31/79

10.A. Type of Action

A.I.D. Contract Cooperating Country Contract Participating Agency Service Agreement Other

10.B. Authorized Agent

AID/W

Estimated Financing

		(1)	(2)	(3)	(4)
		Previous Total	Increase	Decrease	-Total to Date
\$1.00=					
11. Maximum A.I.D. Financing	A. Dollars		405,000		405,000
	B. U.S.-Owned Local Currency				
12. Cooperating Country Contributions	A. Counterpart				
	B. Other				

13. Mission References

14. Instructions to Authorized Agent

This PIO/T authorizes the Contract Office to negotiate a 3 year contract with the University of Illinois, and provide incremental funding for a period of seven months, 4/1/76 to 10/31/76. Scope of Work of the project is given in Attachment #1. The total cost of the 3 year contract shall not exceed \$2,270,600 as recommended by RAC on January 16, 1976 and approved by the DA/AA.

15. Clearances - Show Office Symbol, Signature and Date for all Necessary Clearances.

A. The specifications in the scope of work are technically adequate

TA/AGR, W. Garman, *W Garman/ek* Date: 2/13/76

B. Funds for the services requested are available

TA/W, I. Hornstein, Date:
 TA/RES, M. Rechciol, Date:

C. The scope of work lies within the purview of the initiating and approved Agency Programs

TA/AGR, G. Baird, Date: 2/17/76
 TA/AGR, L. Hesser, Date: 2/13/76

D.

TA/PPU/PPA, C. Molfetto, Date:

E.

TA/AGR, K. Brundage, *K Brundage* Date: 2/17/76

F.

TA/PPU/PPA, H. Mozvnski, Date:

16. For the cooperating country: The terms and conditions set forth herein are hereby agreed to.

17. For the Agency for International Development

18. Date of Signature

Signature and date:

Signature: John Gunning

Title:

Title: Chief, TA/PPU/PPA

AID 1350-1X (9-70)	Cooperating Country TA BUREAU	PIO/T No.	Page 2 of 4 Pages
PIO/T	Project Activity No. and Title Development of Improved Varieties of Soybeans and Supporting Cultural and Marketing Practices for Production in the Tropics, and Information Delivery Systems		

SCOPE OF WORK

19. Scope of Technical Services

A. Objective for which the Technical Services are to be Used

To develop and exploit the potential of the soybean as an efficient source of high quality edible oil and high quality protein for diets of the rural and urban poor.

B. Description

- 1) Develop improved genetic materials for use in LDC soybean breeding programs.
- 2) Improve technologies for rhizobium production and management in tropical ecologies
- 3) Manage and expand the knowledge base in soybean production, protection, and utilization.
- 4) Improve the knowledge base useful for disease control in soybeans.
- 5) Develop a model insect, weed, and disease control management system which can be adapted or modified for specific environments.
- 6) Develop improved soybean seed storage technology.
- 7) Phase out previous activities on home processing of soybeans by October 31, 1976.

Plan of Work appears in Attachment #1.

C. Technicians

(1) (a) Number	(b) Specialized Field	(c) Grade and/or Salary	(d) Duration of Assignment (Man-Months)
See Attachment #2 and #3.			

(2) Duty Post and Duration of Technicians' Service

Urbana, Illinois

(3) Language requirements

No foreign language requiremen

(4) Access to Classified Information

N/A

(5) Dependents Will Will Not **Be Permitted to Accompany Technician**

N/A

D. Financing of Technical Services

(1) By AID - \$ 366,045 (7 month period) **(2) By Cooperating Country -**

See Attachment #3.

20. Equipment and Supplies (Related to the services described in Block 19 and to be procured outside the Cooperating Country by the supplier of these services)

A. (1) Quantity Categories	(2) Description	(3) Estimated Cost		(4) Special Instructions	Total	
		4/1/76- 10/31/76	11/1/76- 3/31/77			4/1/77- 3/31/78
A. Seed & Freight		\$5830	\$4170	\$10,700	\$11,450	\$32,150
B. Seed Analyses		1750	1250	3,000	3,000	9,000
C. Expendable <u>1/</u> Supplies		18490	12510	32,000	37,000	100,000
D. Lab & Field <u>2/</u> Equipment		8370	3130	8,000	10,000	29,500
E. Nutritional Analyses		4100	2900	9,700	5,500	22,200
		<u>\$38,540</u>	<u>\$23,960</u>	<u>\$63,400</u>	<u>\$66,950</u>	<u>\$192,850</u>

1/ Expendable supplies: computer time, office supplies, postage, publications, plant chemicals, field supplies, photo supplies.

2/ Lab and field equipment: replacement parts for vehicles and existing equipment, seed planters, hand cultivators, insect cages, photographic attachments.

B. Financing of Equipment and Supplies

(1) By AID - \$ 38,540 (7-month period)

(2) By Cooperating Country -

21. Special Provisions

- A. This PIO/T is subject to AID (contracting) (PASA implementation) regulations.
- B. Except as specifically authorized by AID, or when local hire is authorized under the terms of a contract with a U.S. Supplier, services authorized under this PIO T must be obtained from U.S. sources.
- C. Except as specifically authorized by AID W, the purchase of commodities authorized under this PIO/T will be limited to the U.S. under Geographic Code 000.

D. Other (specify):

Prior to making any visits to LDCs, the Contractor will review his plans with TA/AGR. He will keep AID Missions in countries to be visited fully informed of proposed visits, ask them to provide any advice they wish regarding timing and content of the visits and to participate if they desire, and will inform the Missions of the outcomes of consultations. He will make his own appointments and logistics arrangements directly. Upon completion of any project funded travel, a copy of the trip report will be provided to the TA/AGR project manager. The report format will be established jointly by the contractor and the project manager.

AID 1350-1X (9-70)	Cooperating Country TA BUREAU	PIO/T No.	Page 4 of 4 Pages
PIO/T	Project/Activity No. and Title Development of Improved Varieties of Soybeans and Supporting Cultural and Marketing Practices for Production in the Tropics, and Information Delivery Systems		

22. Reports by Contractor or Participating Agency (Indicate type, content and format of reports required, including language to be used if other than English, frequency or timing of reports, and any special requirements)

As per Guidelines for Preparation and Submission of Reports to centrally funded contractors dated July 14, 1975.

23. Background Information (Additional information useful to Authorized Agent and Prospective Contractors or Participating Agency; if necessary cross reference Block 19.C(4) above.)

This a new contract which modifies a three-year project with the same title with the University of Illinois, Contract No. AID/csd-3292, AID/CM/ta-c-73-19. PAR, Project Statement, RAC Reviews.

24. Relationship of Contractor or Participating Agency to Cooperating Country and to AID

A. Relationships and Responsibilities

Performance under this contract shall be subject to the technical direction of the Director, Office of Agriculture, Technical Assistance Bureau, AID/W, or his designee.

B. Cooperating Country Liaison Official

Contractor: INTSOY (Dr. William Thompson, Project Leader)
University of Illinois
Urbana, Illinois 61801

C. AID Liaison Officials

Dr. Willard H. Garman
Agency for International Development
Washington, D. C. 20523

**THREE YEAR PLAN OF WORK, including working/months per objective for
first funding period, April 1, 1976 -
October 31, 1976**

Output 1 -- Development of improved genetic materials for use in LDC breeding programs, including production traits, human nutritional needs and consumer acceptability:

- a) Continue development of new crosses of soybean in order to isolate or incorporate desirable characteristics for use in LDC programs;
- b) Continue screening of new acquisitions for identification of desirable traits;
- c) Distribute promising lines for field testing at Puerto Rico, International Research Centers, and in LDCs; and
- d) Assemble and tabulate results from ongoing field trials.

38 work/months plus secretarial.

Output 2 -- Improved technologies for Rhizobium management in the tropics

- a) Identify optimum conditions for storage and transport of Rhizobium japonicum;
- b) Study relationship of Rhizobium strains to soybean varieties to determine feasibility of incorporating high nitrogenase activity into varieties developed for the tropics;
- c) Determine minimum numbers of Rhizobium japonicum needed to produce acceptable tap root nodulation and seed yield in the tropics, through field trials in LDCs; and
- d) Conduct physiological and serological studies on Rhizobium japonicum in the tropics to determine factors affecting its survival and behavior.

11 work/months plus secretarial.

Output 3 -- Expansion and management of knowledge on soybean production, protection, and utilization:

- a) Strengthen ISVEX relationships to promote information exchange and strengthen cooperative research programs;

ISVEX - International Soybean Varieties Experimental Trials

- b) Maintain and expand the TAXIR information system, the UIUC soybean literature collection, and SIRIC, including integration with the Spanish language information bank at the University of Puerto Rico; and
- c) Continue participation in international soybean information network, including publication and distribution of INTSOY publication series.

7 work/months plus secretarial.

Output 4 -- Improve knowledge base for disease control in soybeans:

- a) Identify soybean diseases which limit production in the tropics and subtropics;
- b) Generate basic information on soybean pathogens which will be useable for predicting their spread and impact;
- c) Develop methods to control important diseases; and
- d) Participate in breeding of tropically adapted soybean cultivars with resistance to important pathogens.

14 work/months plus secretarial.

Output 5 -- Develop insect, weed and disease control management systems for tropical and subtropical areas:

- a) Study cultural, biological and genetic methods for controlling insects and weeds. Will be integrated with disease control insofar as vectors are affected in insect and weed control measures; and
- b) Pursue the adaptation of Illinois Pest Management Guidelines in Puerto Rico and other ecological zones.

18 months work/months.

Output 6 -- Develop improved soybean seed storage technology:

- a) Determine optimum seed moisture content in order to maintain acceptable viability for nine-months without ambient temperature control;
- b) Evaluate efficacy of various seed storage containers for storage of seeds at village and farm level; and

TAXIR - Taxonomic Information Retrieval
 UIUC - University of Illinois, Urbana-Champaign
 SIRIC - Soybean Insect Retrieval and Information Center

- c) Investigate the merit in raising moisture content of seed prior to planting.

7 work/months plus secretarial.

Output 7 -- Phase out by October 31, 1976 of activities directed toward technologies for direct human use of soybeans by home and village type processing:

- a) As feasible, complete ongoing studies on more rapid processing concepts, and use of soybeans in weaning foods; and
- b) Prepare and submit final reports on this aspect of work performed under this AID contract.

14 work/months plus secretarial.

Total: 109 W/M (estimated, output 5 includes some clerical input)

**ESTIMATED BUDGET
THREE-YEAR RESEARCH PROGRAM**

	<u>4/1/76- 10/31/76</u>	<u>11/1/76- 3/31/77</u>	<u>4/1/77- 3/31/78</u>	<u>4/1/78- 3/31/79</u>	<u>Total</u>
I. Salaries and Wages	166,226	105,924	290,705	328,290	891,145
II. Fringe benefits	22,776	14,484	39,540	43,940	120,740
III. Indirect costs	109,711	69,909	191,865	216,670	588,155
IV. Travel and transportation	38,916	27,084	65,000	74,300	205,300
V. Other direct costs	28,416	20,209	53,000	59,175	160,800
VI. Materials and supplies	<u>38,540</u>	<u>23,959</u>	<u>63,400</u>	<u>66,950</u>	<u>192,849</u>
	404,585	261,569	703,510	789,325	2,158,989

9310560-17
FD-AAC-821

COST REIMBURSEMENT TYPE CONTRACT

AGENCY FOR INTERNATIONAL DEVELOPMENT
 NEGOTIATED CONTRACT NO. 73-73 CONTRACT TYPE Cost Reimbursement
 NEGOTIATED PURCHASE ORDER NO. 73-73 AMOUNT \$1,111,000
 ACT OF 1961, AS AMENDED, AND EXECUTIVE ORDER 11789

CONTRACT FOR:
 Development of Improved Varieties of Sorghums

ISSUING OFFICE (Name and Address)
 Technical Assistance Branch
 Central Operations Division
 Office of Contract Management
 Agency for International Development
 Washington, D.C. 20523

CONTRACTOR (Name and Address)
 The Board of Trustees of the
 University of Illinois
 Urbana, Illinois 61801

ADMINISTRATION BY
 Issuing Office

CITY, STATE AND ZIP CODE
 URBANA, ILLINOIS 61801

MAIL VOUCHER (Original & 3 copies)
 TO: Central Services Division
 Office of Financial Management
 Agency for International Development
 Washington, D.C. 20523

ACCOUNTING AND APPROPRIATION DATA
 FIO/T NO. 251-17-100-00-73-313773
 APPROPRIATION NO. 251-171000
 ALLOTMENT NO. 251-31-000-00-02-31

EFFECTIVE DATE Apr 01 1973 ESTIMATED COMPLETION DATE March 31, 1976

TYPES OF BUSINESS (CHECK APPROPRIATE BOXES)

<input type="checkbox"/>	SOLE PROPRIETORSHIP	<input type="checkbox"/>	SMALL BUSINESS
<input type="checkbox"/>	PARTNERSHIP	<input type="checkbox"/>	LABOR SURPLUS AREA
<input type="checkbox"/>	JOINT VENTURE	<input checked="" type="checkbox"/>	UNIVERSITY
<input checked="" type="checkbox"/>	CORPORATION, INCORPORATED IN THE STATE OF <u>ILLINOIS</u>		

The United States of America, hereinafter called the Government, represented by the Contracting Officer executing this contract, and the Contractor agree that the Contractor shall perform all the services set forth in the attached Schedule, for the consideration stated therein. The rights and obligations of the parties to this contract shall be subject to and governed by the Schedule and the General Provisions. To the extent of any inconsistency between the Schedule or the General Provisions and any specifications or other provisions which are made a part of this contract, by reference or otherwise, the Schedule and the General Provisions shall control. To the extent of any inconsistency between the Schedule and the General Provisions, the Schedule shall control.

This Contract consists of this Cover Page, the Schedule of 27 Pages, including the Table of Contents and the General Provisions (form AID 1120-41C, dated 7-72).

NAME OF CONTRACTOR
 The Board of Trustees of the University of Illinois

UNITED STATES OF AMERICA
 AGENCY FOR INTERNATIONAL DEVELOPMENT

BY (Signature of authorized individual)
[Signature]
 NAME OF CONTRACTOR
 Controller

BY (Signature of Contracting Officer)
[Signature]
 NAME OF CONTRACTING OFFICER
 V. G. [Name]

DATE
[Signature]

DATE
 APR 20 1973

CCHEDULE

COST REIMBURSEMENT TYPE CONTRACT

Contract No. AID/cm/ta-c-73-19

TABLE OF CONTENTS

- SCHEDULE .

The Schedule, on pages 1 through 27 , consists of this Table of Contents and the following Articles:

ARTICLE I	-	STATEMENT OF WORK	ARTICLE VIII	-	COSTS REIMBURSABLE TO CONTRACTOR
ARTICLE II	-	TECHNICAL DIRECTIONS	ARTICLE IX	-	ESTABLISHMENT OF OVERHEAD RATES
ARTICLE III	-	KEY PERSONNEL	ARTICLE X	-	PERSONNEL COMPENSATION
ARTICLE IV	-	LEVEL OF EFFORT	ARTICLE XI	-	ADDITIONAL SCHEDULE CLAUSES
ARTICLE V	-	PERIOD OF CONTRACT	ARTICLE XII	-	ALTERATIONS IN CONTRACT
ARTICLE VI	-	ESTIMATED COST			
ARTICLE VII	-	BUDGET			

GENERAL PROVISIONS

The General Provisions applicable to this contract consist of form AID 1420-41C entitled "General Provisions - Costs Reimbursement Type Contract" dated 7-72 , which includes provisions 1 through 41; and form AID 1420-41D entitled "Additional General Provisions - Cost Reimbursement Type Contract", dated 7-72 , which includes provisions 1 through 14 .

SCHEDULE

ARTICLE I - STATEMENT OF WORK

For a period as hereinafter set forth in the Schedule, the Contractor shall make available and employ its research and development facilities and personnel at the level of effort hereinafter set forth, and shall perform a research and development program directed toward the development of improved varieties of soybeans.

A. Background

Soybeans are rapidly becoming an important food legume crop in developing nations. Each day they are contributing more protein needed to more nearly balance the diets of people living where cereals and roots and tubers are the major food crops. However, the rate of increase is much too slow to satisfy this ever increasing need.

With a concentrated effort on the selection of soybean varieties with high protein content, varieties with even higher protein content can be bred to alleviate malnutrition in developing nations, especially in the tropics. Heretofore in tropical environments, soybeans have yielded only a fraction of their known capacity.

With the development of higher yielding soybean varieties for the tropics, it is expected that this naturally high protein legume will become competitive in yield with other food crops. Soybeans are presently the most extensively grown legume crop in the world. With more protein needed in tropical countries and soybeans being a warm-season crop, they are considered to be one of the food legumes having the greatest potential in that environment.

B. Specific Statement of Work

At the University of Illinois International Soybean Program (INTSOY), College of Agriculture, the Contractor will undertake:

1. Development of technical assistance and research linkages in tropical soybean variety improvement, cultural practices, inoculation, pest control, and harvesting, processing, and storage methods;
2. Research to screen the soybean for broad adaptation to the tropical soils, tropical climates and insect and disease resistance;
3. Research on isolating and testing Rhizobium strains for their effect on fixing nitrogen and increasing yields;
4. Assistance and backstopping LDC institutions in conducting cooperative adaptive research in soybean improvement;
5. Programs of formal and practically oriented training and guidance in soybean research;
6. Demonstration in selected countries of Latin America, Africa and the Far East, of the University of Illinois process for rapidly rendering soybeans available in the village and at the home level as a human food in an effort to determine what regional modifications the process may require in order to make the product acceptable to the local palate and usable in soy-based foods; and

7. To make available improved soybean varieties and production to IDC's and cooperating research institutions for trial under the individual conditions of the developing countries.

C. Exhibit I entitled "Total Work Plan (Detailed)" is attached hereto and made a part hereof.

D. It is contemplated that there will be no subcontracting under this contract.

ARTICLE II - TECHNICAL DIRECTIONS

Performance of the work hereunder shall be subject to the technical directions of the cognizant A.I.D. Scientific/Technical Office indicated on the Cover Page. As used herein, "Technical Directions" are directions to the Contractor which fill in details, suggest possible lines of inquiry or, otherwise complete the general scope of the work. "Technical Directions" must be within the terms of this contract and shall not change or modify them in any way.

ARTICLE III - KEY PERSONNEL

A. The key personnel which the Contractor shall furnish for the performance of this contract are as follows:

Key personnel

Dr. Earl R. Leng

B. The personnel specified above are considered to be essential to the work being performed hereunder. Prior to diverting any of the specified individuals to other programs, the Contractor shall notify the Contracting Officer reasonably in advance and shall submit justification (including proposed substitutions) in sufficient detail to permit evaluation of the

impact on the program. No diversion shall be made by the Contractor without the written consent of the Contracting Officer; provided, that the Contracting Officer may ratify in writing such diversion and such ratification shall constitute the consent of the Contracting Officer required by this clause. The listing of key personnel may, with the consent of the contracting parties, be amended from time to time during the course of the contract to either add or delete personnel, as appropriate.

ARTICLE IV - LEVEL OF EFFORT

A. The estimated level of effort for the performance of this contract shall be 409 total man-months of direct labor.

B. The estimated composition of the total man-months of direct labor is as follows:

	<u>No. Man-months</u>
Home Office Professional	171
Home Office Non-Professional	171
<u>Field Staff Professional</u>	91
Field Staff Non-Professional	36

C. It is understood and agreed that the rate of man-months may fluctuate in pursuit of the technical objective provided such fluctuation does not result in the utilization of the total man-months of effort prior to the expiration of the term hereof, and it is further understood and agreed that the number of months of effort for any classification may be utilized by the Contractor in any other direct labor classification if necessary in the performance of the work.

D. The Contracting Officer may, by written order, direct the Contractor to increase the average monthly rate of utilization of direct labor to such an extent that the total man-months of effort, specified above, would be utilized prior to the expiration of the term hereof. Any such order shall specify the degree of acceleration required and the revised term hereof resulting therefrom.

ARTICLE V - PERIOD OF CONTRACT

A. The effective date of this contract is April 1, 1973 and the estimated completion date is 3/31/76.

B. In the event that the Contractor fails to furnish the level of effort set forth herein for the specified term, then the Contracting Officer may require the Contractor to continue performance of the work beyond the estimated completion date until the Contractor has furnished the specified level of effort or until the estimated cost of the work .

for such period shall have been expended.

ARTICLE VI - ESTIMATED COST, OBLIGATED FUNDS, AND LIMITATION OF FUNDS

The total estimated cost of this contract is \$1,011,525 of which \$249,996 is obligated. Notwithstanding the total estimated cost of this contract, the Government's liability for payment is limited to the funds presently allotted to this contract which is \$249,996. (Reference General Provision No. 8, entitled "Limitation of Funds").

ARTICLE VII - BUDGET

The following budget sets limitations for reimbursement of dollar costs for individual line items. Within the total estimated cost of this contract for each funding period, the contractor may adjust line item amounts as reasonably necessary for the performance of this contract.

BUDGET

Line Item	AMOUNT		TOTAL
	Fr: 4/1/73 To: 6/30/74	Fr: 7/1/74 To: 3/31/76	
Salaries and Wages	\$121,250	\$383,000	\$ 504,250
Fringe Benefits	15,800	50,350	66,150
Travel and Transportation	22,800	49,850	72,650
Other Direct Costs	11,950	34,850	46,800
Equipment and Supplies	10,000	18,000	28,000
Overhead	<u>68,196</u>	<u>225,179</u>	<u>293,375</u>
Total Estimated Cost	\$249,996	\$711,529	\$1,011,525

ARTICLE VIII - COSTS REIMBURSABLE TO CONTRACTOR

The United States dollar costs allowable under the contract shall be limited to reasonable, allocable, and necessary costs determined in accordance with the Clause of the General Provisions of this Contract entitled "Allowable Cost, Fixed Fee, and Payment".

ARTICLE IX - ESTABLISHMENT OF OVERHEAD RATE

Pursuant to the provisions of General Provision No. 10 of this contract entitled "Indirect Costs (Overhead) - Predetermined", rate or rates shall be established for each of the Contractor's accounting periods during the term of this Contract. For the initial period the rates are:

<u>TYPE</u>	<u>PERIOD</u>	<u>ON-CAMBUS</u>	<u>OFF-CAMBUS</u>
Predetermined	Fr: 7-1-72 To: 6-30-74	63.0	28.0
Provisional	Fr: 7-1-74 To: Until amended	63.0	28.0

Distribution Base: Direct Salaries and Wages including holiday, vacation, and sick leave allowances.

ARTICLE X - PERSONNEL COMPENSATION

A. Limitations

Compensation of personnel which is charged as a direct cost under this contract, like other costs, will be reimbursable in accordance with the Schedule Article entitled "Costs Reimbursable and Logistic Support to Contractor", and the General Provision entitled "Allowable Costs, Fixed Fee, and Payment", and other applicable provisions of this contract but subject to the following additional specified understandings which set limits on items which otherwise would be reasonable, allocable, and allowable.

1. Approvals

Salaries and wages may not exceed the Contractor's established policy and practice, including the Contractor's established pay scale for equivalent classifications of employees, which will be certified to by the Contractor, nor may any individual salary or wage, without approval of the Contracting Officer, exceed the employee's current salary or wage or the highest rate of annual salary or wage received during any

full year of the immediately preceding three years, provided that if the work is to be performed by employees serving overseas for a period in excess of one year, the normal base salary may be increased in accordance with Contractor's established policy and practice, but not to exceed 10 percent of base U.S. salary excluding benefits. There is a ceiling on reimbursable salaries and wages paid to a person employed directly under the contract of the maximum salary rate of FSR-1 (or the equivalent daily rate of the maximum FSR-1 salary, if compensation is not on an annual basis), unless advance written approval is given by the Contracting Officer.

2. Salaries During Travel

Salaries and wages paid while in travel status will not be reimbursed for a travel period greater than the time required for travel by the most direct and expeditious air route.

3. Return of Overseas Employees

Salaries and wages paid to an employee serving overseas who is discharged by the Contractor for misconduct or security reasons will in no event be reimbursed for a period which extends beyond the time required to return him promptly to his point of origin by the most expeditious air route plus accrued vacation leave.

4. Merit or Promotion Increase

Merit or promotion increases may not exceed those provided

by the Contractor's established policy and practice. With respect to employees performing work overseas under this contract, one merit or promotion increase of not more than 5% of the employee's base salary may, subject to the Contractor's established policy and practice, be granted after employee's completion of each twelve month period of satisfactory services under the contract or, if the employee is presently employed by the Contractor, whenever the employee would otherwise be eligible. Merit promotion increases exceeding these limitations or exceeding the maximum salary of FSR-1 may be granted only with the advance written approval of the Contracting Officer.

5. Consultants

Consultant services will be reimbursed in connection with the services to be provided hereunder. No compensation for consultants will be reimbursed unless their use under the contract has the advance written approval of the Contracting Officer; and if such provision has been made or approval given, compensation shall not exceed, without specific approval of the rate by the Contracting Officer, (1) the current compensation or the highest rate of annual compensation received by the consultant during any full year of the immediately preceding three years or (2) maximum daily salary rate of a Foreign Service Officer Class 1 whichever is less. No consultant may be reimbursed under this contract

for more than 90 days in any twelve-month period without the advance written approval of the Contracting Officer.

Note: The daily rate of a Foreign Service Office Class 1 is determined by dividing the annual salary by 260 days.

6. Third Country and Cooperating Country Nationals

No compensation for third country or Cooperating Country nationals will be reimbursed unless their use under the contract is authorized in the Schedule or has the prior written approval of the Contracting Officer. Salaries and wages paid to such persons may not, without specific written approval of the Contracting Officer, exceed either the Contractor's established policy and practice; or the level of salaries paid to equivalent personnel by the A.I.D. Mission in the Cooperating Country; or the prevailing rates in the Cooperating Country, as determined by A.I.D., paid to personnel of equivalent technical competence.

7. Work Week

a. Nonoverseas Employee. The work week for the Contractor's nonoverseas employees shall not be less than the established practice of the Contractor.

b. Overseas Employee. The work week for the Contractor's overseas employees shall not be less than 40 hours and shall be scheduled to coincide with the work week for those employees of the A.I.D. Mission and the Cooperating Country associated with the work of this contract.

B. Definitions

As used herein, the terms "Salaries," and "Wages," and "Compensation" mean the periodic remuneration received for professional or technical services rendered exclusive of overseas differential or other allowances associated with overseas service, unless otherwise stated. The term "compensation" includes payments for personal services (including fees and honoraria). It excludes earnings from sources other than the individual's professional or technical work, overhead or other charges.

ARTICLE XI - ADDITIONAL SCHEDULE CLAUSES

A. Special Provision Regarding Additional General Provision No. 6 entitled "Personnel".

In accordance with paragraph (a) of Additional General Provision No. 6, entitled "Personnel", whereunder the Contractor may not send individuals outside of the United States to perform work under this Contract without the prior written approval of the Contracting Officer, the Contracting Officer does, hereby, provide said approval for those individuals required to travel outside the United States; provided, however, that concurrence with the assignment and/or travel of any and all said individuals outside the United States is obtained, in writing, from the Cognizant Technical Office of A.I.D. prior to their assignment and/or travel, abroad.

The travel of foreign nationals to Contractor's Campus and/or other location in the United States is also subject to the prior written approval

from the Cognizant Technical Office of A.I.D. This does not apply to foreign national graduate students and/or researchers employed as Contractor's Campus.

B. Utilization of Excess and Near Excess Foreign Currencies

Full utilization of excess and near excess foreign currencies is an objective of the U.S. Government. The Contractor should obtain its supply of certain foreign currencies which have been determined by the U.S. Treasury Department to be excess to its needs from the U.S. Government -- either through the local U.S. Disbursing Officer or through the Treasury Department in Washington, D.C.

Travel to, through, or from certain countries shall, at A.I.D.'s option, be funded from U.S.-owned foreign currency. When A.I.D. intends to exercise this option, it will so advise the Contractor after receipt of the Contractor's notice of intent to travel required under this Contract. A.I.D. will issue a Government Transportation Request (GTR) which the Contractor may exchange for tickets, or A.I.D. will issue the tickets directly.

Per Diem (subsistence) expense of the Contractor in certain countries shall, at A.I.D.'s option, be funded from U.S.-owned foreign currency. If such is to be the case, A.I.D. will so advise the Contractor after receipt of the Contractor's notice of intent to travel to those countries, or the employees of the Contractor will be so notified upon contact with the USAID Mission when first arriving in such a country.

The use of said U.S.-owned currencies will constitute a dollar charge to this Contract.

ARTICLE XII - AMENDATIONS IN CONTRACT

A. General Provision No. 3, entitled "Limitation of Cost (Dec. 1970)".

Delete in its entirety and in lieu thereof insert the following:

"8. Limitation Of Funds .

(a) It is estimated that the cost to the Government for the performance of this Contract will not exceed the estimated cost to the Government set forth in the Schedule, and the Contractor agrees to use his best efforts to perform the work specified in the Schedule and all obligations under this Contract within such estimated cost.

(b) The amount presently available for payment and allotted to this Contract and the period of performance which it is estimated the allotted amount will cover, are specified in the Schedule. It is contemplated that from time to time additional funds will be allotted to this Contract up to the full estimated cost to the Government set forth in the Schedule. The Contractor agrees to perform or have performed work on this Contract up to the point at which the total amount paid and payable by the Government pursuant to the terms of this Contract approximates but does not exceed the total amount actually allotted to the Contract.

(c) If at any time the Contractor has reason to believe that the costs which he expects to incur in the performance of this Contract in the next succeeding sixty (60) days, when added to all costs previously incurred, will exceed seventy-five percent (75%) of the total of the amount then allotted to the Contract, the Contractor shall notify the Contracting Officer in writing to that effect. The notice shall state the estimated amount of additional funds required and the period set forth in the Schedule. Sixty (60) days prior to the end of the

period specified in the Schedule the Contractor will advise the Contracting Officer in writing as to the estimated amount of additional funds, if any, that will be required for the timely performance of the work under the Contract or for such further period as may be specified in the Schedule or otherwise agreed to by the parties. If, after such notification, additional funds are not allotted by the end of the period set forth in the Schedule or an agreed date substituted therefor, the Contracting Officer will, upon written request by the Contractor, terminate this Contract pursuant to the provisions of the Termination clause on such date. If the Contractor, in the exercise of his reasonable judgment, estimates that the funds available will allow him to continue to discharge his obligations hereunder for a period extending beyond such date, he shall specify the later date in his request, and the Contracting Officer, in his discretion, may terminate on that later date.

(d) Except as required by other provisions of this Contract specifically citing and stated to be an exception from this clause, the Government shall not be obligated to reimburse the Contractor for costs incurred in excess of the amount from time to time allotted to the Contract, and the Contractor shall not be obligated to continue performance under the Contract (including actions under the Termination clause) or otherwise to incur costs in excess of the total of the amount then allotted to the Contract unless and until the Contracting Officer has notified the Contractor in writing that such allotted amount has been increased and has specified in such notice an increased amount constituting the total amount then allotted to the Contract. If the Contractor estimates that the estimated cost set forth in the Schedule, such estimated cost shall

be correspondingly increased. No notice, communication or representation in any other form or from any person other than the Contracting Officer shall affect the amount allotted by the Government to this Contract. In the absence of the specified notice, the Government shall not be obligated to reimburse the Contractor for any costs in excess of the total amount then allotted to the Contract, whether those excess costs were incurred during the course of the Contract or as a result of termination. When and to the extent that the amount allotted to the Contract has been increased, any costs incurred by the Contractor in excess of the total of the amount previously allotted shall be allowable to the same extent and in the same percentage as if such costs had been incurred after such increase in the amount allotted; unless the Contracting Officer issues a termination or other notice and directs that the increase is solely for the purpose of covering termination or other specified expenses.

(e) Change orders issued pursuant to the Changes clause of this Contract shall not be considered an authorization to the Contractor to exceed the amount allotted in the Schedule in the absence of a statement in the change order, or other contract modification, increasing the amount allotted.

(f) Nothing in this clause shall affect the right of the Government to terminate this Contract. In the event this Contract is terminated, the Government and the Contractor shall negotiate an equitable distribution of all property produced or purchased under the Contract, based upon the share of costs incurred by each.

Delete all reference to Fixed-Fee;

Delete Sub-paragraph (a) (1) (i) in its entirety and in lieu thereof insert the following:

"(i) Subpart 1-15.3 (Principles for Determining Costs Applicable to Research and Development Under Grants and Contracts with Educational Institutions) of the Federal Procurement Regulations as in effect on the date of this Contract; and".

C. General Provision No. 10, entitled "Negotiated Overhead Rates (Dec. 1970)".

Delete in its entirety and in lieu thereof insert the following:

"10. INDIRECT COSTS (OVERHEAD) - PREDETERMINED

(a) Notwithstanding the provisions of any other clause of this Contract, the allowable indirect costs under this Contract shall be obtained by applying predetermined indirect cost rates to bases agreed upon by the parties, as specified in Schedule Article VII of this Contract.

(b) The Contractor, as soon as possible but not later than three (3) months after the expiration of his fiscal year, shall submit to the Contracting Officer, with a copy to the cognizant audit activity, a proposed predetermined indirect cost rate or rates based on the Contractor's actual cost experience during that fiscal year, together with supporting cost data. Negotiations of predetermined indirect cost rates shall be undertaken as promptly as practicable after receipt of the Contractor's proposal.

(c) Allowability of costs and acceptability of cost allocation methods shall be determined in accordance with the provisions of Subpart 1-15.3 (Principles for Determining Costs Applicable to Research and Development under Grants and Contracts with Educational Institutions)

of the Federal Procurement Regulations as in effect on the date of this Contract.

(d) The results of each negotiation shall be set forth in a modification to this Contract, which shall specify (i) the agreed predetermined indirect cost rates, (ii) the bases to which the rates apply, (iii) the fiscal year unless the parties agree to a different period for which the rates apply, and (iv) the specific items treated as direct costs.

(e) Pending establishment of predetermined indirect cost rates for any fiscal year or different period agreed to by the parties, the Contractor shall be reimbursed either at the rates fixed for the previous fiscal year or other period or at billing rates acceptable to the Contracting Officer subject to appropriate adjustment when the final rates for that fiscal year or other period are established.

(f) Any failure by the parties to agree on any predetermined indirect cost rate or rates under this clause shall not be considered a dispute concerning a question for decision by the Contracting Officer within the meaning of the "Disputes" clause of this Contract. If for any fiscal year or other period specified in the Schedule of this Contract the parties fail to agree to a predetermined indirect cost rate or rates, it is agreed that the allowable indirect costs under this Contract shall be obtained by applying negotiated final indirect cost rates in accordance with the terms of the "Indirect Costs (Overhead) - Negotiated" clause set forth in Part 7-15.951 of the A.I.D. Procurement Regulations as in effect on the date of this Contract.

(g) Allowable indirect costs for the period until the end of the Contractor's fiscal year during which performance begins, shall be obtained by applying the predetermined indirect cost rates set forth in the Schedule to the bases set forth therein".

D. General Provision No. 19, entitled "Government Property (Aug. 1970)"

Delete in its entirety and, in lieu thereof, insert the provision entitled "Government Property Clause for Cost-Reimbursement Contracts with Nonprofit and Educational Institutions" which is attached hereto as Attachment A.

E. General Provision No. 23, entitled "Termination for Default or for Convenience of the Government."

Delete in its entirety and, in lieu thereof, insert the following:

"TERMINATION FOR THE CONVENIENCE OF THE GOVERNMENT"

A. The performance of work under this contract may be terminated, in whole or from time to time in part, by the Government whenever for any reason the Contracting Officer shall determine that such termination is in the best interest of the Government. Termination of work hereunder shall be effected by delivery to the Contractor of a Notice of Termination specifying the extent to which performance of work under the contract is terminated and the date upon which such termination becomes effective.

B. After receipt of the Notice of Termination the Contractor shall cancel his outstanding commitments hereunder covering the procurement of materials, supplies, equipment and miscellaneous items. In addition, the Contractor shall exercise all reasonable diligence to accomplish the cancellation or diversion of his outstanding commitments covering personal services and materials, if any, of such a nature to the extent

that they relate to the performance of any work terminated by the notice. With respect to such canceled commitments, the Contractor agrees to (i) settle all outstanding liabilities and all claims arising out of such cancellation of commitments with the approval or ratification of the Contracting Officer, to the extent he may require, which approval or ratification shall be final for all purposes of this clause, and (ii) assign to the Government, in the manner, at the time, and to the extent directed by the Contracting Officer, all of the right, title and interest of the Contractor under the order and subcontracts so terminated, in which case the Government shall have the right, in its discretion, to settle or pay any or all claims arising out of the termination of such orders and subcontracts.

C. The Contractor shall submit his termination claim to the Contracting Officer promptly after receipt of a Notice of Termination, but in no event later than one year from the effective date thereof, unless one or more extensions in writing are granted by the Contracting Officer upon written request of the Contractor within such one year period or authorized extension thereof. Upon failure of the Contractor to submit his termination claim within the time allowed, the Contracting Officer may, subject to any review required by A.I.D. Regulations in effect as of the date of execution of this contract, determine, on the basis of information available to him, the amount, if any, due to the Contractor by reason of the termination and shall thereupon pay to the Contractor the amount so determined.

D. Any determination of costs under paragraph C shall be governed by the cost principles set forth in Part. 15, Subpart 3, of the A.I.D.

procurement Regulation as in effect on the date of this contract.

E. Subject to the provisions of paragraph C above, and subject to any review required by A.I.D. Regulations in effect as of the date of execution of this contract, the Contractor and the Contracting Officer may agree upon the whole or any part of the amount or amounts to be paid to the Contractor by reason of the termination under this clause, which amount or amounts may include any reasonable cancellation charges thereby incurred by the Contractor and any reasonable loss upon outstanding commitments for personal services which he is unable to cancel subject to the provisions of paragraph H, below, provided, however, that in connection with any outstanding commitments for personal services which the Contractor is unable to cancel, the Contractor shall have exercised reasonable diligence to divert such commitments to its other activities and operations. Any such agreement shall be embodied in an amendment to this contract and the Contractor shall be paid the agreed amount.

F. The Government may from time to time, under such terms and conditions as it may prescribe, make partial payments against costs incurred by the Contractor in connection with the terminated portion of this contract, whenever, in the opinion of the Contracting Officer, the aggregate of such payments is within the amount to which the Contractor will be entitled hereunder. If the total of such payments is in excess of the amount finally agreed or determined to be due under this clause, such excess shall be payable by the Contractor to the Government upon demand; provided, that if such excess is not so paid upon demand, interest thereon shall be payable by the Contractor to the Government at the rate of 6 percent per annum, beginning thirty (30) days from the date of such demand.

G. The Contractor agrees to transfer title and deliver to the Government, in the manner, at the time and to the extent, if any, directed by the Contracting Officer, such information and items which, if the contract had been completed, would have been required to be furnished to the Government, including: (i) completed or partially completed plans, drawings, and information; and (ii) materials or equipment produced or in process or acquired in connection with the performance of the work terminated by the notice. Other than the above, any termination inventory resulting from the termination of the contract may, with the written approval of the Contracting Officer, be sold or acquired by the Contractor under the conditions prescribed by and at a price or prices approved by the Contracting Officer. The proceeds of any such disposition shall be applied in reduction of any payments to be made by the Government to the Contractor under this contract or shall otherwise be credited to the price or cost of work covered by this contract or paid in such other manner as the Contracting Officer may direct. Pending final disposition of property arising from the termination, the Contractor agrees to take such action as may be necessary, or as the Contracting Officer may direct, for the protection and preservation of the property related to this contract which is in the possession of the Contractor and in which the Government has or may acquire an interest.

H. In the event the Contractor's services are terminated by A.I.D. pursuant to this Clause, or in the event that an employee's services are terminated by the Contractor at the request of A.I.D. or the Cooperating Country for reasons other than misconduct, the Contractor will be reimbursed for salary payments to staff members of subsidiaries (excluding overseas incentive, differential and allowances) to the extent the

Contractor is liable to make such payments under its agreements with such staff members, provided that such staff members are not otherwise gainfully employed during the compensable period following such termination or, if gainfully employed but at a lesser compensation, payments will be made to equalize the difference between such lesser compensation and the employee's salary (excluding overseas incentive, differential and allowances) and provided further, that such payments shall not extend beyond one year from the date of the employee's termination, or the date on which this contract would have expired but for termination, whichever is earlier. The Contractor agrees to exert its best efforts to minimize costs under this provision.

I. Any disputes as to questions of fact which may arise hereunder shall be subject to the "Disputes" clause of this contract."

F. General Provision No. 30, entitled "Rights In Data (Dec. 1970)".

Delete in its entirety and in lieu thereof insert the following:

"30. Rights in Data and Publication.

(a) Rights in Data

(1) The term "Subject Data" as used herein includes writings, software, electronic or punch card stored data, models, sound recordings, pictorial reproductions, drawings, or other graphic representations, and works of any of similar nature (whether or not copyrighted) which are developed or used in connection with this contract. The term does not include financial reports, cost analyses,

and other information incidental to Contract administration. The term "software" means any computer programs with supporting documentation and specifications necessary to produce desired outputs. The term excludes programs supplied by the hardware manufacturer. The term "model" in this context means formal, analytic structures which describe certain inter-related aspects of economic, social, or political behavior. The complete model shall include supporting information and equations which describe and explain basic structure assumptions. "Subject Data" is Data which is specified to be delivered under this Agreement.

(b) Publication

(1) A.I.D.'s policy with respect to publication, or release to parties other than those specifically authorized, of material gathered or developed under contracts with educational institutions is set forth in the Statement of Policy published in the Federal Register, as revised. That policy is applicable to this Contract.

(2) Unless otherwise provided in the Schedule, and subject to A.I.D.'s pre-publication review as hereinafter set forth, no permission or authorization from A.I.D. will be required prior to publication, release, or reproduction of any Data.

(3) No one employed under this contract will have access to classified material for performance of work under this contract; however, if, in its pre-publication review, A.I.D. should discover that any classified material has inadvertently been included in a contract manuscript, it will notify the contractor, who agrees that the identified material will not be published and that the contractor will ensure that the material is available from unclassified sources.

(c) Pre-publication Review

The Contractor agrees to allow A.I.D. the opportunity to review any Data intended for publication and provide comments thereon, and agrees to give serious consideration to such comments prior to publication. The Contractor shall deliver to A.I.D. a notice of intent to publish together with a copy of the proposed publication not later than the date of its submission to the publisher. A.I.D. reserves the right to disclaim endorsement of the opinions expressed in the proposed publication of Subject Data, and to dissociate itself from sponsorship or publication of any other Data. In the event A.I.D. exercises its right to disclaim or dissociate as aforesaid, the Contractor shall be so notified in writing by the Contracting Officer; such notice shall contain an appropriate statement of disclaimer or dissociation which shall be inserted in the publication.

(d) Acknowledgments

All publications shall acknowledge the contributions of the parties hereto, unless such acknowledgment is not desired by the contributing parties.

(e) Copies

In case of publication of any of the Data described hereinabove, a copy of such publication shall be supplied to the Contracting Officer at no cost to the Government.

(f) Personnel Commitments

The Contractor undertakes to secure from all personnel engaged in the performance of this Contract commitments adequate to assure that the Contractor will be able to discharge its obligations under this "Rights in Data and Publication" clause."

G. General Provision No. 31, entitled "Release of Information (Dec. 1970)".

Delete in its entirety and in lieu thereof insert the following:

"31. PRICE CERTIFICATION (Applicable to all contracts in excess of \$2,500 unless and until altered, amended, or revoked by action of the Cost of Living Council or by such competent authority as the Council may specify):

(a) Prior to the payment of invoices under this Contract, the Contractor shall place on, or attach to, each invoice submitted the following certification:

"I hereby certify that amounts invoiced herein do not exceed the lower of (i) the contract price, or (ii) maximum levels established in accordance with Executive Order 11640, January 26, 1972."

(b) The Contractor agrees to insert the substance of this clause, including this paragraph (b), in all subcontracts for supplies or services issued under this Contract".

H. General Provision No. 39, entitled "Utilization of Minority Business Enterprises (August 1971)".

Delete the second sentence in Paragraph (b) and in lieu thereof insert the following:

"As used in this Contract, the term 'Minority Business Enterprise' means a business, at least 50 percent of which is owned by Minority Group Members or, in case of publicly owned business, at least 51 percent of the stock of which is owned by Minority Group Members."

I. Additional General Provision No. 4, entitled "Title To and Care of Property (Aug. 1970)"

Delete in its entirety

J. Add the following:

1. Attachment B, General Provision No. 12 entitled "Payment of Interest on Contractor's Claims."

2. Attachment C, entitled "Guidelines for Preparation of the Research Annual Report."

Government Property Clause for Cost-Reimbursement Contracts with Nonprofit and Educational Institutions (7-13.705)

(a) Government-furnished Property

The Government shall deliver to the Contractor, for use in connection with and under the terms of this Contract, the property described as Government-furnished property in the Schedule or specifications, together with such related data and information as the Contractor may request and as may reasonably be required for the intended use of such property (hereinafter referred to as "Government-furnished property"). The delivery or performance dates for the supplies or services to be furnished by the Contractor under this Contract are based upon the expectation that Government-furnished property suitable for use will be delivered to the Contractor at the times stated in the Schedule or, if not so stated, in sufficient time to enable the Contractor to meet such delivery or performance dates. In the event that Government-furnished property is not delivered to the Contractor by such time or times, the Contracting Officer shall, upon timely written request made by the Contractor, make a determination of the delay, if any, occasioned the Contractor and shall equitably adjust the estimated cost, fixed fee, or delivery or performance dates, or all of them, and any other contractual provisions affected by any such delay, in accordance with the procedures provided for in the clause of this Contract entitled "Changes". In the event that Government-furnished property is received by the Contractor in a condition not suitable for the intended use, the Contractor shall, upon receipt thereof, notify the Contracting Officer of such fact and, as directed by the Contracting Officer, either (1) return such property at the Government's expense or otherwise dispose of the property or

(ii) effect repairs or modifications. Upon completion of (i) or (ii) above, the Contracting Officer upon written request of the Contractor shall equitably adjust the estimated cost, fixed fee, or delivery or performance dates, or all of them, and any other contractual provision affected by the return or disposition, or the repair or modification in accordance with the procedures provided for in the clause of this Contract entitled "Changes". The foregoing provisions for adjustment are exclusive and the Government shall not be liable to suit for breach of Contract by reason of any delay in delivery of Government-furnished property or delivery of such property in a condition not suitable for its intended use.

(b) Changes in Government-furnished Property

(1) By notice in writing, the Contracting Officer may (i) decrease the property provided by the Government under this Contract, or (ii) substitute other Government-owned property for property to be provided by the Government, or to be acquired by the Contractor for the Government, under this Contract. The Contractor shall promptly take such action as the Contracting Officer may direct with respect to the removal and shipping of property covered by such notice.

(2) In the event of any decrease in or substitution of property pursuant to Subparagraph (1) above, or any withdrawal of authority to use property provided under any other contract or lease, which property the Government had agreed in the Schedule to make available for the performance of this Contract, the Contracting Officer, upon the written request of the Contractor (or, if the substitution of property causes a decrease in the cost of performance, on his own initiative), shall equitably adjust such contractual

provisions as may be affected by the decrease, substitution, or withdrawal, in accordance with the procedures provided for in the "Changes" clause of this Contract.

(c) Title

Title to all property furnished by the Government shall remain in the Government. In order to define the obligations of the parties under this clause, title to each item acquired by the Contractor pursuant to this Contract shall pass to and vest in the Government upon purchase. All Government-furnished property, together with all property acquired by the Contractor title to which vests in the United States Government under this paragraph, is subject to the provisions of this clause and is hereinafter collectively referred to as "Government Property". Title to Government property shall not be affected by the incorporation or attachment thereof to any property not owned by the Government, nor shall such Government property, or any part thereof, be or become a fixture or lose its identity as personalty by reason of affixation to any realty.

(d) Use of Government Property

The Government property shall, unless otherwise provided herein or approved by the Contracting Officer, be used only for the performance of this Contract.

(e) Maintenance and Repair of Government Property

The Contractor shall maintain and administer in accordance with sound business practice a program for the maintenance, repair, protection and preservation of Government property so as to assure its full availability and usefulness for the performance of this Contract. The Contractor shall

take all reasonable steps to comply with all appropriate directions or instructions which the Contracting Officer may prescribe as reasonably necessary for the protection of the Government property.

The Contractor shall submit, for the review and written approval of the Contracting Officer, a records system for property control and a program for orderly maintenance of Government property.

(1) Property Control - The property control system shall include but not be limited to the follow

(i) Identification of each item of Government property acquired or furnished under the Contract, by a serially controlled identification number and by description of item. Each item must be clearly marked "Property of U.S. Government"

(ii) The price of each item of property acquired or furnished under the Contract

(iii) The location of each item of property acquired or furnished under the Contract.

(iv) A record of any usable components which are permanently removed from items of Government property as a result of modification or otherwise.

(v) A record of disposition of each item acquired or furnished under the Contract.

(vi) Date of order and receipt of any item acquired or furnished under the Contract.

The official property control records shall be kept in such condition that at any stage of completion of the work under this Contract, the status of property acquired or furnished under this Contract may be

readily ascertained. A report of current status of all items of property acquired or furnished under the Contract shall be submitted yearly concurrently with the annual report.

(2) Maintenance Program - The Contractor's maintenance program shall be such as to provide for, consistent with sound industrial practice and the terms of the Contract: (i) disclosure of need for and the performance of preventive maintenance, (ii) disclosure and reporting of need for capital type rehabilitation, and (iii) recording of work accomplished under the program.

(A) Preventive Maintenance - Preventive maintenance is maintenance generally performed on a regularly scheduled basis to prevent the occurrence of defects and to detect and correct minor defects before they result in serious consequences.

(B) Records of Maintenance - The Contractor's maintenance program shall provide for records sufficient to disclose the maintenance actions performed and deficiencies discovered as a result of inspections.

A report of status of maintenance of Government property shall be submitted annually concurrently with the annual report.

(f) Risk of Loss

(1) The Contractor shall not be liable for any loss of or damage to the Government property, or for expenses incidental to such loss or damage, except that the Contractor shall be responsible for any such loss or damage (including expenses incidental thereto):

(i) which results from willful misconduct or lack of good faith on the part of any of the Contractor's directors or officers or on the part of any of his managers, superintendents, or other equivalent representatives,

who has supervision or direction of all or substantially all of the Contractor's business, or all or substantially all of the Contractor's operations at any one plant, laboratory, or separate location in which this Contract is being performed;

(ii) which results from a failure on the part of the Contractor, due to the willful misconduct or lack of good faith on the part of any of his directors, officers, or other representatives mentioned in (i) above, (A) to maintain and administer, in accordance with sound business practice, the program for maintenance repair, protection, and preservation of Government property as required by (e) above, or (B) to take all reasonable steps to comply with any appropriate written directions of the Contracting Officer under (e) above;

(iii) for which the Contractor is otherwise responsible under the express terms of the clause or clauses designated in the schedule;

(iv) which results from a risk expressly required to be insured under some other provision of this Contract, but only to the extent of the insurance so required to be procured and maintained, or to the extent of insurance actually procured and maintained, whichever is greater; or

(v) which results from a risk which is in fact covered by insurance or for which the Contractor is otherwise reimbursed, but only to the extent of such insurance or reimbursement; provided that, if more than one of the above exceptions shall be applicable in any case, the Contractor's liability under any one exception shall not be limited by any other exception;

(2) The Contractor shall not be reimbursed for, and shall not include as an item of overhead, the cost of insurance, or any provision for a reserve, covering the risk of loss of or damage to the Government property, except to the extent that the Government may have required the Contractor to carry such insurance under any other provision of this Contract.

(3) Upon the happening of loss or destruction of or damage to the Government property, the Contractor shall notify the Contracting Officer thereof, shall take all reasonable steps to protect the Government property from further damage, separate the damaged and undamaged Government property, put all the Government property in the best possible order, and furnish to the Contracting Officer a statement of:

- (i) the lost, destroyed, and damaged Government property;
- (ii) the time and origin of the loss, destruction, or damage;
- (iii) all known interests in commingled property of which the Government property is a part; and
- (iv) the insurance, if any, covering any part of or interest in such commingled property.

The Contractor shall make repairs and renovations of the damaged Government property or take such other action as the Contracting Officer directs.

(4) In the event the Contractor is indemnified, reimbursed, or otherwise compensated for any loss or destruction of or damage to the Government property, he shall use the proceeds to repair, renovate or replace the Government property involved, or shall credit such proceeds against the cost of the work covered by the Contract, or shall otherwise reimburse the Government

as directed by the Contracting Officer. The Contractor shall do nothing to prejudice the Government's right to recover against third parties for any such loss, destruction, or damage, and upon the request of the Contracting Officer, shall, at the Government's expense, furnish to the Government all reasonable assistance and cooperation (including assistance in the prosecution of suit and the execution of instruments of assignment in favor of the Government) in obtaining recovery.

(g) Access

The Government, and any persons designated by it, shall at all reasonable times have access to the premises wherein any Government property is located, for the purpose of inspecting the Government property.

(h) Disposition of Government Property

Upon completion or expiration of this Contract, any Government property which has not been consumed in the performance of this Contract, or which has not been disposed of as provided for elsewhere in this clause, or for which the Contractor has not otherwise been relieved of responsibility, shall be disposed of in the same manner, and subject to the same procedures, as is provided in the clause of this Contract entitled "Termination for the Convenience of the Government" with respect to termination inventory. Pending final disposition of such property, the Contractor agrees to take such action as may be necessary, or as the Contracting Officer may direct, for the protection and preservation thereof.

(i) Communications

All communications issued pursuant to this clause shall be in writing.

PAYMENT OF INTEREST ON CONTRACTOR'S CLAIMS

(a) If an appeal is filed by the contractor from a final decision of the Contracting Officer under the Disputes clause of this contract, denying a claim arising under the contract, simple interest on the amount of the claim finally determined owed by the Government shall be payable to the Contractor. Such interest shall be at the rate determined by the Secretary of the Treasury pursuant to Public Law 92-41, 85 Stat. 97, from the date the Contractor furnishes to the Contracting Officer his written appeal under the Disputes clause of this contract, to the date of (1) a final judgment by a court of competent jurisdiction, or (2) mailing to the Contractor of a supplemental agreement for execution either confirming completed negotiations or carrying out a decision of a board of contract appeals.

(b) Notwithstanding (a), above, (1) interest shall be applied only from the date payment was due, if such date is later than the filing of appeal, and (2) interest shall not be paid for any period of time that the Contracting Officer determines the Contractor has unduly delayed in pursuing his remedies before a board of contract appeals or a court of competent jurisdiction.

BEST AVAILABLE COPY

January 20, 1972

GUIDELINES FOR PREPARATION
OF THE
RESEARCH ANNUAL REPORT

The attached guidelines suggest the format and the detail for annual research reports that are required in all research contracts. The research contractor will submit thirty-five copies of the report with appendices to the A.I.D. Project Manager. The A.I.D. Project Manager will submit two copies to IM/RUR and two copies to the A.I.D. Reference Center.

The outline should prove useful to the contractor in preparing the report, and provide an improved basis for annual project reviews. The contractor is encouraged to develop a self-contained report as outlined below in approximately fifteen double-spaced pages. Additional material may be annexed as necessary for a comprehensive report. The fifteen page report is intended to provide a barebones statement of the effectiveness of research resources and methods in producing research results according to annual work plans, and the significance of these research results for the solution of the problem being addressed. Annexed material is essential for a critical review of assertions regarding findings, significance, etc.

BEST AVAILABLE COPY

- 1/ "Report Summary": Statistical Information (Item A) and the Narrative Summary of Accomplishments (Item B) should be reported on a single page. This page will be for general public use as well as project management purposes, and should be written for a general rather than a technical audience.
- 2/ Item 3 - Contract Period (as amended): Report the original date of the contract and closing date as prescribed by the contract or any amendment thereto.
- 3/ Items A 6-8: These items refer to expenditures including firm obligations by the contractor. Obligations are the contractor's legal but unpaid commitments, i.e., subcontracts purchase orders, etc.; and other related accruals through the end of the reporting period. A "contract year" is one between anniversary dates of the contract.

BEST AVAILABLE COPY.

REPORT SUMMARY 1/

- A.
1. Project Title and Contract Number:
 2. Principal Investigator, Contractor and Mailing Address:
 3. Contract Period (as amended): 2/ from _____ to _____
 4. Period covered by Report: from _____ to _____
 5. Total A.I.D. funding of contract to date:
 6. Total expenditures and obligations through previous contract year: 3/
 7. Total expenditures and obligations for current year: 3/
 8. Estimated expenditures for next contract year:
- B. Narrative Summary of Accomplishments and Utilization

(In this space provide a concise statement of the principal accomplishments during (1) the period of the report and (2) life of the project in relation to research objectives and actual or potential operational significance.

This information does not substitute for a full discussion of the same points required in the body of the Annual Research Report as outlined below.)

BEST AVAILABLE COPY

ANNUAL RESEARCH REPORT

A. General Background

Prepare a concise statement that provides the background and rationale that led to the initiation of the project. This summary should state the nature and importance of the problem to which the research is addressed, and the rationale that links the research activity to the problem.

B. Statement of Project Objectives as Stated in the Contract

The purpose of this section is to record in a precise and concise way the objectives of the research project. The objectives as stated in the contract may have been interpreted, expanded or further defined in other documents and mutually agreed to by A.I.D. and the contractor. This section should reflect the contractual objectives as modified by these supplementary understandings.

C. Continued Relevance of Objectives

Does your research to date, or other circumstances, indicate a need for modification of project objectives as stated in the contract? If so, in what respects?

D. Accomplishments to Date

1. Findings: Provide a statement of the principal and significant findings and other accomplishments for the reporting period as they relate to the anticipated results in the year's work plan. (See material for the year similar to that requested in G.I. below for the coming year.)

Discuss the operational significance of the findings of the current year's research for attainment of project objectives as stated in Section B above. The discussion should include reference to existing knowledge, recent research findings by others, and cumulative findings and accomplishments of this project.

Also discuss side effects of the work, positive or negative. For example, do the findings to date suggest unexpected complications for the application of findings; do they suggest the need for more direct approaches to the problem than were originally anticipated; or is the research developing information and insights not expected in the scope of the work?

2. Interpretation of Data and Supporting Evidence:

Summarize briefly the evidence and analysis that support the findings cited above. To permit a critical analysis of the evidence and analysis, expand as necessary in an appendix to each copy of the report.

BEST AVAILABLE COPY

3. **Research Design:** State briefly any significant modifications made in the research design prior to the current reporting period.

Are the present techniques, instruments or mode of inquiry appropriate and/or optimal for the study design? In view of the findings of the past year or your experience with the research measures employed, do you recommend modifying (1) the research design or (2) research techniques? For example, have there been special problems of data availability, sampling, data processing, or ineffective techniques? Have research findings revealed technical relationships that suggest a continuation of present methods or do they suggest a new approach?

E. Dissemination and Utilization of Research Results

1. Briefly describe efforts made under the contract to disseminate the results of the research project. Attach as appendices two lists: (1) a bibliographic list and an abstract not exceeding 200 words of papers and publications developed under the contract and (2) a list of short statements that identify each known use of materials produced by the project for seminars, conferences, translations, or as background material for speeches, policy statements, etc.

2. Cite evidence and cases known to you that findings of the research project are being used in LDCs, the U.S., or both, in training, direct application to the problem, etc.

3. Has the experience of the past year suggested new or more effective ways to expand the use of research results? If so, discuss the experience and as appropriate include proposed steps in the work plan (Item G below). Indicate whether your proposals can be carried out under current provisions of the contract, or would require new contract arrangements by A.I.D.

4. Discuss the extent and nature of considerations to involve LDC personnel and/or institutions as an appropriate activity of the project. If judged appropriate, discuss the kind and extent of LDC involvement in (a) planning the project, (b) the execution of the field work, (c) the analysis and reporting of results. Plans to involve LDCs in the future should be reflected in the work plan in Item G (4) below.

5. Under separate cover forward four copies of publications, seminar reports, translations and other materials representing efforts to disseminate results of the research project, and evidence of the results being utilized by LDC or U.S. people or institutions.

F. Statement of Expenditures and Obligations and Contractor Resources

Provide a statement of expenditures and obligations related to the budget plan for the year. This statement should show expenditure and obligations for each of the (1) major inputs (Personnel, equipment, travel, etc.) according to (2) the major accomplishments or work targets that had been planned for the year's work.

BEST AVAILABLE COPY

Identify significant problems or accomplishments in the progress of the project related to the volume, effectiveness, or scheduling of the manpower, equipment, travel, etc., made available by these expenditures.

Discuss significant changes or modifications in project management, in the staffing pattern, physical facilities, institutional environment, etc.

G. Work Plan and Budget Forecast for Coming Year

Taking into consideration the past year's progress and expenditures and the work remaining to be done over the life of the project, present a work plan and budget for the coming year.

1. anticipated accomplishments for the coming year.
2. procedures to be used and activities to be carried out.
3. significant factors that you anticipate that will promote or impede accomplishments.
4. a plan for dissemination and utilization of the expected results of the research in the U.S. and in LDCs as applicable.
5. a budget statement that shows planned expenditures for each of the major inputs (personnel, equipment, travel, LDC involvement, etc.) according to the major accomplishments, or work targets that are planned for the coming year's work.

H. Appendices

- Reports of technical data and analyses (Par. D. 2)
- A bibliographic list with abstracts of papers and publications (Par. E. 1)
- A list of uses made of research findings and reports (Par. E. 1)
- Other appendices as appropriate.

BEST AVAILABLE COPY

I. TOTAL WORK PLAN (Detailed)

A. Staffing and Administration

All staff positions will be filled at or soon after the inception of the project (1 April 1973).

The headquarters office will be established and specific arrangements for cooperative linkages will be made.

B. Variety Trials

1. Major zonal trials, consisting of up to 30 established or new promising varieties, will be conducted. At least 10, and probably about 25, individual trial locations will be involved.
2. Preliminary trials of promising new material resulting from the Illinois-Puerto Rico program and other cooperating countries will be conducted in Puerto Rico, Colombia, Brazil, Nigeria, India, Thailand and other interested countries. The leading varieties from these trials will be the candidates for entry in more advanced major zone trials.

C. Plant Breeding Activities

Seed lots of germ plasma strains which appear most promising in meeting the stated objectives of the breeding program will be assembled at Urbana, and samples will be transferred to the major cooperating location in Puerto Rico. Some material will be sent to cooperators in other locations, as requested and deemed appropriate. Crosses will be made between and among strains considered potentially valuable in

the program. Particular emphasis will be given to incorporation of genetic male-sterility into the most generally useful breeding stocks. This could facilitate the production of large numbers of crosses in future generations, and also make possible a study of breeding methods, the major one involving maximum incorporation into a synthetic population of different genetic sources for desired factors which have been observed in the collection of related wild types.

Major objectives of the plant-breeding program will include high yield, suitable photoperiodic response, wide adaptability in tropical and subtropical environments, and resistance to limiting disease and insect pests. Attention will also be given to level and quality of protein and nutritional value. Analyses usually will be performed at the Urbana-Champaign site, although some may be done in Puerto Rico.

D. Cultural Practice Trials

Studies of most effective planting date, plant population, and row width will be conducted, including variety differentials, in Puerto Rico and in five or more developing countries, probably including Colombia, Nigeria, India, Peru, Thailand and Indonesia.

E. Rhizobium Inoculation Trials

Commercially available inoculants will be tested, and comparisons of inoculation vs. no inoculation, made in Colombia, Brazil, Puerto Rico, Peru, Nigeria, India, Thailand and Indonesia.

F. Computerized Germ Plasm Information System

As part of the agronomic work related to AID-csd 3292, soybean germ-plasm information published in the USDA-ARS Regional Soybean Laboratory manuals has been coded under a modified taxonomic information retrieval system (TAXIR) and approximately 25,000 computer cards have been punched. Altogether these represent 3900 germ plasm collections, rated for about 140 variables.

It is now proposed to begin expansion of this listing to include data developed by the INTSOY program and selected cooperating soybean workers in overseas sites. When these additions are well underway, information retrieval will be possible on requests from major cooperating agencies.

Operations of this system will be more closely integrated with the soybean insect taxonomic information system, also developed under AID-csd 3292.

G. Insect Control and Entomological Studies

Work on insect problems will be continued on the basis presently approved for project csd-3292. There will be a continuing effort to keep the reference collection of scientific literature on insects of soybeans up to date and to provide computer print-outs on all requests for information from foreign researchers. The Information Center currently contains over 4,700 titles and abstracts covering the literature of insects associated with soybeans and insect-borne diseases of soybeans. The synoptic collection of soybean insects which includes

pests, predators, and parasites, will continue to be expanded. The insect collection now contains ca. 30,000 specimens plus bio-data from 17 foreign countries and all soybean-producing states in the U.S.A. The insect collection is computerized to permit rapid retrieval of phenological, zoogeographical, and population problems of insects and mites associated with soybeans. Extended visits will be made to major cooperating locations, particularly those in Puerto Rico connected with soybean production and plant breeding activities. Emphasis will be placed on research and education for developing insect-pest management systems for soybeans in tropical regions.

Food Utilization and Nutritional Value

Studies being conducted under the existing contract (AID/csd 3292) will be continued and their scope broadened. Processes will be developed which are suitable for direct food use of whole soybeans, both at the home/village level and for more industrialized processing. Products to be developed will be in the categories of:

1. Fresh-cooked foods
2. Canned products
3. Beverages
4. Powder or flake products
5. Spreads
6. Snack foods

Work with specific products will include studies and reference to

acceptability and preferences of various national and ethnic groups who are likely product consumers.

Effects of important processing variables on palatability, chemical and biological stability, and nutritional value will be assessed. Special emphasis will be placed on the development of weaning foods with high nutritional value, involving combinations of whole soybeans with readily-available, low-cost indigenous food supplies.

The demonstration program conducted under AID-csd 3292 will be continued and expanded, with specific sites to be chosen in consultation with AID/W, USAID field missions, and local scientific personnel. Brazil, Peru and Colombia are likely sites in Latin America; Nigeria and possibly Tanzania in Africa; and India, Pakistan, and Indonesia in Asia.

Training, Workshops, and Communications

At least two major field seminar/workshops will be held for cooperating countries. One of these will be in Puerto Rico. Training of specialists in the various subject-matter areas will be conducted by INTSOY and UPR personnel during site visits to cooperating institutions. Distribution of a "newsletter" will be undertaken.

Travel

Each professional subject-matter specialist will visit each cooperating country, and as many of the project sites as possible, during the contract period.

DEPARTMENT OF STATE
AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D.C. 20523

The Board of Trustees of the
University of Illinois
Urbana, Illinois

Subject: Amendment No. 1 to
Contract No. AID/CM/ta-C-73-19

Pursuant to the Foreign Assistance Act of 1961, as amended, and Executive Order 11223, the subject contract is hereby amended as follows:

1. Article XII - Alterations in Contract - Delete Paragraph F in its entirety and, in lieu thereof, insert the following:

"F. General Provision No. 30, entitled 'Rights in Data (Dec 1970)'.
Delete in its entirety and, in lieu thereof, insert the following:

'30. RIGHTS IN DATA AND PUBLICATION (May 1973)

(a) Rights in Data

(1) The term 'Data' as used herein includes writings, software, electronic or punch card stored data, models, sound recordings, pictorial reproductions, drawings, or other graphic representations, and works of any similar nature (whether or not copyrighted) which are developed or created in the course of the performance of this Contract, or from materials or information acquired as a result of this Contractor's activities hereunder. The term 'Data' does not include financial reports, cost analyses, and other information incidental to contract administration. The term 'software' means

CERTIFIED A TRUE COPY THIS
12th DAY OF July 1973
BY Caroline Adams

any computer programs with supporting documentation and specifications necessary to produce desired outputs. The term excludes programs supplied by the hardware manufacturer. The term 'model' in this context means formal, analytic structures which describe certain interrelated aspects of economic, social, or political behavior. The complete model shall include supporting information and equations which describe and explain basic structure and assumptions.

'Subject Data' is Data which is specified to be delivered under this contract.

(2) For copyright purposes, all Subject Data shall be the property of the Government. The Contractor agrees not to assert any rights at common law or equity in Subject Data, nor to establish any claim to statutory copyright therein.

(3) The Contractor shall be responsible for assuring that no copyrighted matter is included in Data furnished hereunder without the written permission of the copyright owner for the Government to use such copyrighted matter in the manner described in (4) below.

(4) The Contractor agrees to grant and does hereby grant to the Government and its officers, agents and employees acting within the scope of their official duties, a royalty-free, non-exclusive, and irrevocable license throughout the world to publish, translate, reproduce, deliver, perform, use, and dispose of, and to authorize others to do so, all Data, whether or not now or hereafter covered by copyright.

(5) Nothing contained in this clause shall imply a license to the Government under any patent or be construed as affecting the scope of any license or other right otherwise granted to the Government under any patent.

(6) Paragraphs (3) and (4) above are not applicable to material furnished to the Contractor by the Government and incorporated into Data produced under the Contract, provided such incorporated material is identified by the Contractor at the time the Data is furnished to the Government.

(b) Publication of Data

(1) A.I.D.'s policy with respect to publication, or release to parties other than those specifically authorized, of material gathered or developed under contracts with educational institutions is set forth in the Statement of Policy published in the FEDERAL REGISTER of May 14, 1973 (38 F.R. 12621). That policy is applicable to this Contract.

(2) Unless otherwise provided in the Schedule, and subject to A.I.D.'s pre-publication review as hereinafter set forth, no permission or authorization from A.I.D. will be required prior to publication release, or reproduction of any Data.

(3) No one employed under this Contract will have access to classified material for performance of work under this Contract; however, if, in its pre-publication review, A.I.D. should discover that any classified material has inadvertently been included in a contract manuscript, it will notify the Contractor, who agrees that the identified material will not be published unless he can demonstrate that the material is available from unclassified sources.

(c) Pre-publication Review

The Contractor agrees to allow A.I.D. the opportunity to review any Data intended for publication and provide comments thereon, and agrees to give serious consideration to such comments prior to publication. The Contractor shall deliver to A.I.D. a notice of intent to publish together with a copy of the proposed publication not later than the date of its submission to the publisher. A.I.D. reserves the right to disclaim endorsement of the opinions expressed in the proposed publication of Subject Data, and to dissociate itself from sponsorship or publication of any other Data. In the event A.I.D. exercises its right to disclaim or dissociate as aforesaid, the Contractor shall be so notified in writing by the Contracting Officer; such notice shall contain an appropriate statement of disclaimer or dissociation which shall be inserted in the publication.

(d) Acknowledgments

All publications shall acknowledge the contributions of the parties hereto, unless such acknowledgment is not desired by the contributing parties.

(e) Copies

In case of publication of any of the Data described hereinabove, a copy of such publication shall be supplied to the Contracting Officer at no cost to the Government.

(f) Personnel Commitments

The Contractor shall secure from all personnel engaged in the performance of this Contract commitments adequate to assure that the Contractor will be able to discharge its obligations under this 'Rights in Data and Publication' clause."

2. General Provision No. 9, entitled "Allowable Cost, Fixed Fee, and Payment" - Delete paragraphs (b) through (i) and, in lieu thereof, insert the following:

"(b) ADVANCE PAYMENT

1. Subject to the provisions hereinafter set forth, A.I.D. shall make an initial advance payment to the Grantee in an amount of \$112,000.

2. Request for Advance Payment. To request the initial advance payment, the Grantee will submit Voucher Form SF-1034 and 1034(a) to the Office of Financial Management, FM/CSD, A.I.D., Washington, D.C. 20525.

3. Special Account Number. Until all advance payments made hereunder are liquidated, the initial advance and all other payments under the Grant shall be deposited in the Grantee's regular Bank Account, and a separate account number shall be assigned by the Grantee for operations of this Grant. All receipts and disbursements shall be recorded thereunder by the Grantee's Fiscal Department in such manner that it will be possible to ascertain the balance in the advance payment account at any time. The records thereof shall be preserved and be subject to inspection and audit in accordance with General Provision No. 12. None of the funds in the Special Account Number shall be mingled with other funds of the Grantee prior to their withdrawal from the Account as hereinafter provided.

4. Use of the Funds. The funds in the Special Bank Account or Accounts may be withdrawn by the Grantee solely for the purpose of making payments for items of allowable cost as provided in this Grant, or to reimburse the Grantee for such items of allowable cost or for such other purposes as the Grant Officer may approve in writing.

5. Replenishment and Liquidation. Following the initial advance payment, A.I.D. will reimburse the Contractor not more often than monthly in amounts equal to reported expenditures in order to replenish the advance funds on an imprest basis. Such replenishment shall be made upon submission to the Office of Financial Management, A.I.D., Voucher Form SF-1034 and 1034(a), each voucher identified by the appropriate A.I.D. Grant Number, properly executed, in the amount of dollar expenditures made during the period covered, which voucher form shall include a fiscal report in a form substantially as set forth below:

	<u>Grant No.</u> <u>Budget Category</u>	<u>Expenditures</u>	
		<u>To Date</u>	<u>This Period</u>
1.		\$	\$
2.		\$	\$

The fiscal report shall include a certification signed by an authorized representative of the Grantee as follows:

"The undersigned hereby certifies: (1) that payment of the sum claimed under the voucher is proper and due under the terms of the Grant;

(2) that the information is correct and such detailed supporting information as A.I.D. may require will be furnished by the Grantee promptly upon request.

BY _____
TITLE _____ DATE _____

Replenishment will be made until such time as total reimbursements plus the initial advance payment equal the total amount of this Grant. Thereafter, vouchers for expenditures, which shall be marked 'NO-PAY' by the Grantee before submission, will not be reimbursed, but will be applied to liquidate the remaining outstanding advance. In the event that the total amount of such subsequent vouchers is insufficient to completely liquidate the outstanding advance, the Grantee shall make repayment to A.I.D. of all unexpended portions of the advance dollar funds which are not obligated under this contract at the time of submission of the Final Voucher.

6. Interest. Any interest earned on this advance account shall accrue to and be paid to the Agency for International Development."

Except as expressly herein amended, the subject contract is hereby ratified, confirmed, and continued in full force and effect in accordance with its terms.

This Amendment shall be effective as of the date of signature by the A.I.D. Contracting Officer designated below.

THE BOARD OF TRUSTEES OF
THE UNIVERSITY OF ILLINOIS

BY H. O. Farber

PRINTED NAME H. O. Farber

TITLE Comptroller

DATE 5 July 1973

ATTEST: Earl W. Porter
Earl W. Porter, Secretary

UNITED STATES OF AMERICA
AGENCY FOR INTERNATIONAL DEVELOPMENT

BY V. C. Perelli

PRINTED NAME V. C. Perelli

TITLE Contracting Officer

DATE JUL 09 1973