

Batch # 37

1. SUBJECT CLASSIFICATION	A. PRIMARY Agriculture	AF00-0000-0000
	B. SECONDARY Plant production	

2. TITLE AND SUBTITLE
Terminal report for services rendered in seed processing and testing under the agreement between AID and Mississippi State University, 1958-1971

3. AUTHOR(S)
(101) Miss. State Univ. Seed Technology Laboratory

4. DOCUMENT DATE: 1971	5. NUMBER OF PAGES 103p.	6. ARC NUMBER ARC
---------------------------	-----------------------------	----------------------

7. REFERENCE ORGANIZATION NAME AND ADDRESS
Miss. State

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

9. ABSTRACT

10. CONTRCL NUMBER PN-AAC-220	11. PRICE OF DOCUMENT
12. DESCRIPTORS Seed production Seeds Technical assistance	13. PROJECT NUMBER
	14. CONTRACT NUMBER AID/W-607-CTS
	15. TYPE OF DOCUMENT

PN-AAC-220

ST - TR2
July 1971



**TERMINAL
REPORT
to the**

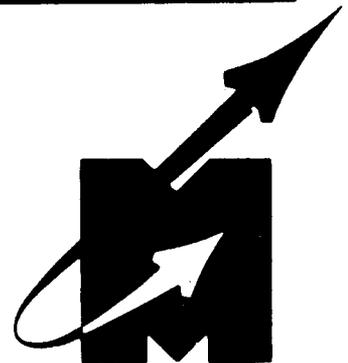
AGENCY for INTERNATIONAL DEVELOPMENT

**for
Services Rendered
Under The Agreement
Between The
Agency for International Development
and
Mississippi State University**

AID-W-607

March 18, 1958 - March 31, 1971

**SEED TECHNOLOGY LABORATORY
MISSISSIPPI STATE UNIVERSITY
STATE COLLEGE, MISSISSIPPI**



INDEX

	Page
Report Summary	1
 Reports for Services Rendered	
March 18, 1959 - March 17, 1959	6
March 18, 1959 - March 17, 1960	7
March 18, 1960 - March 17, 1961	8
March 18, 1961 - March 17, 1962	11
March 18, 1962 - March 17, 1963	13
March 18, 1963 - March 17, 1964	15
March 18, 1964 - March 17, 1965	19
March 18, 1965 - March 17, 1966	22
March 18, 1966 - March 17, 1967	27
March 18, 1967 - June 30, 1968	37
July 1, 1968 - January 1, 1970	49
July 1, 1968 - March 31, 1969 (Statistical Summary) . .	55
April 1, 1969 - March 31, 1970 (Statistical Summary) .	57
April 1, 1970 - March 31, 1971 (Statistical Summary) .	60

Appendices

I. University Staff Contributing to AID/W-607 Contract .	65
II. Overseas Assignments	67
III. Chronological Listing of Technical Reports, Training Materials and Special Papers	69
IV. International Students and Participants	82
V. Report of the Special Task Force Established to Review and Evaluate MSU/AID/W-607	89
VI. Summary of Contractor's Expenditures	100

REPORT SUMMARY

TITLE: Terminal Report to the Agency for International Development on the Services Rendered under the Agreement Between the Agency for International Development and Mississippi State University AID/W-607

AUTHORS: James C. Delouche and Howard C. Potts

PERIOD OF REPORT: March 18, 1958 - March 31, 1971

PROJECT TITLE: AID/W-607 "Seed Processing and Testing"

CONTRACTOR: Mississippi State University

SUMMARY

Mississippi State University's involvement in seed program work in the LDC's began in 1956 when the first "Special Course on Seed Improvement" for international participants was given on our campus. The course was sponsored by ICA and FAS, and continues on an annual basis to this date. Two years later, on March 18, 1958, an agreement was entered into between Mississippi State University and AID under terms of which MSU agreed to provide development, training, and technical services in the area of seed improvement to the less developed countries receiving technical assistance from the U. S. This was contract AID/W-607. The Seed Technology Laboratory was charged by the University with carrying out its responsibilities under the contract in cooperation with other Departments (see Appendix I).

The services produced for and the resulting activities engaged in can generally be classified into three broad categories: technical assistance and services, development of essential technology and information, and training.

Technical Assistance

During the 13 years the contract was in effect, specific consultation visits and follow-up work has been provided to 26 countries (Appendix II). Additionally, 12 to 15 other countries received substantial assistance as a follow-up to brief stopover visits made in connection with other assignments, written requests from AID Mission personnel or as a result of visits by AID staffers and seed specialists from the LDC's to our laboratory. Indeed every day spent on an overseas assignment required at least two days labor "at home".

Basically, the consultations and backstopping involved:

- (1) Plans and designs for specific facilities.
- (2) Assistance and advice on operations.
- (3) On-the-job training.
- (4) General in-country seed training.
- (5) Program development.

Program development (planning, organization, and so on) was listed last because, although it was prominent among the objectives of the contract, assistance in initial planning and program development was rarely requested. Rather, we were most often called on after a program of some type had been initiated, and the problems became almost insurmountable, or to assist only with specific elements of the program.

While problem solving and brush-fire fighting work of this type were urgently needed, we strongly felt that timely assistance in the planning stage could have minimized the number and complexity of problems that arose later, and that as another consequence, funds and resources expended might have been more effectively and efficiently used.

As measured by level of seed program development, the results of this technical assistance were successful, partially successful and unsuccessful in about the same proportions as any other technical assistance venture. But in terms of the development of human resources - men and women with an appreciation and understanding of seeds and their importance - we don't count any failures. We always worked at home and in the LDC's - with people - for we learned long ago that progress is and must be effected through people.

Some of the plans we helped develop were never implemented or fully implemented because advisors and their counterparts changed, and their replacements turned to other things. Changes in key personnel - both in the AID Missions and in the Ministries of Agriculture or other counterpart agencies - with the resulting lack of continuity of interest, effort and support were a recurring and frustrating problem in our 13 years experience.

In some countries, portions of the plans developed were implemented and the rest was left hanging. Perhaps, facilities of the size and type requested were not really needed at the time assistance was given. In this connection, we noticed several "second generation" requests for essentially the same type of assistance provided in earlier years. Recently the tone has been more urgent - and sometimes rather desperate.

It was interesting to us that the spread of the "green revolution" among the LDC's could be followed by the requests for technical assistance or information on seed operations. If the high yielding varieties continue to be cutting edge of this revolution, there can be no doubt but that more and more technical assistance in the seed area will be needed and requested by USAID and other Technical Assistance Missions around the world.

Development of Essential Technology and Information

Since its establishment in 1950, the Seed Technology Laboratory has been engaged essentially in creating a new discipline or a specialty in agriculture. During much of this period we were pretty much alone, because, with the exception of Seed Testing, there was no basic background information - no literature - in Seed Technology other than what we and a few others had gathered from diverse sources, developed and recorded. Thus, our laboratory became an information and advisory center to seed specialists around the world - literally from Afghanistan to Zambia, including both the developed and less developed countries. Our correspondence grew each year the the number of visitors increased. Much of the technology and information we developed never went beyond the mimeograph stage, so great was and is the demand (see Appendix III).

It was our task not only to record and disseminate information, but to develop it as well. In our technical assistance work with the Missions we encountered many problems - particularly in the areas of seed drying and storage - which had no tried and tested solution. Sometimes we guessed at the unknown parameters - and usually were pretty close. More often, though, we had to build several models, do much testing and evaluation, and talk with a lot of folk from aerophysicists to retired farmers.

The information developed and disseminated has had an enormous influence on seed programs in the LDC's whatever their state of development. It would be hard to find a seed program in the LDC's that has not been influenced in some way by developmental research work conducted under the auspices of this contract.

Training

Lack of trained, knowledgeable manpower in the LDC's continues to be one of the serious bottlenecks in seed program development. Our laboratory has done yeomen service in the training field for 20 years - and we have not felt that it should be dropped or even changed to any extent. If U. S. seedsmen still need basic training can it be different in the developing countries?

The U. S. training directly supported by the contract was normally of a short term nature (1 to 15 days). The trainees included AID staff technicians, AID contractor's technicians, seed specialists with the Foundations and many participants on training and observation tours sponsored by AID, USAID Missions, the Foundations, FAO and so on. Some years these numbers exceeded 300 and a "tailored" program was developed for each person or group in an effort to fulfill their specific needs and interests. Unfortunately, we did not maintain a comprehensive list of the thousands of individuals on short term consultations or training programs.

Although some of the training we gave was not directly under the Contract, we simply could not have justified the tremendous effort expended without some of the informational material and experiences developed under W-607. Forty-three students from 18 developing countries obtained B.S. or graduate degrees in Agronomy-Seed Technology during the course of this contract. Additionally, 15 non-degree graduate students have received 6 to 12 months special and academic training just during the past two years. From 1956 to 1970, 214 agriculturists from 48 countries participated in the annual 5 or 6 week Seed Improvement Training Course. These participants are listed in Appendix IV.

We organized and conducted 6 regional seed training courses, 3 held in South America, one in the Far East and 2 in Central America. Recently we presented in-country training courses in Columbia and Ecuador. Twenty-five to thirty participants were enrolled in each of these courses. These regional and in-country courses allowed greater numbers of indigenous personnel to receive their basic training in seed technology at far less cost per person than sending them to the U. S., a practice that should be continued, particularly from the cost-benefit standpoint.

Not all - perhaps not even a majority of the trainees and students were or are working in seed programs. Many were plant breeders, extension workers, economists, administrators, and so on. But, they also needed to understand and have some knowledge of the role, composition, technology and management of seed programs. Many of these persons are leaders in their countries, others are rising to positions of influence. They will be heard from and listened to in the years ahead.

It is the unanimous belief of all the staff who contributed to the work of this contract - that our most satisfying work was in the training area - in working with people - and that in the years to come, this will prove to be the most significant contribution of this contract and our efforts.

General

During 1970, a team of AID Technical and Administrative personnel completed a review and evaluation of the activities and services performed under the contract (Appendix V). This resulted in the contract work being given an "outstanding" rating. We are justifiably proud of the achievement. It is our opinion that the contract was mutually beneficial to AID, the University and, most importantly, the hundreds who have increased their knowledge concerning seeds because the contract existed.

Another result of the "review" was the decision to terminate this contract and replace it with a more effective document. The new document (Basic Ordering Agreement AID/csd 2976) more accurately specified the broad scope of work to be accomplished and updates the concepts and guidelines under which the services will be implemented. Thus, the active projects initiated under AID/W-607 are being continued without interruption.

SERVICES RENDERED
UNDER THE AGREEMENT
BETWEEN THE
AGENCY FOR INTERNATIONAL DEVELOPMENT
AND
MISSISSIPPI STATE UNIVERSITY

AID-W-607

On March 18, 1958, an agreement was entered into between Mississippi State University and the Agency for International Development under which Mississippi State agreed to provide certain seed research, training, and advisory services, through AID/W, to those less developed countries throughout the world receiving technical assistance from the United States. The Mississippi Seed Technology Laboratory was charged with carrying out the University's responsibilities under this contract.

SERVICES RENDERED

Since initiation of the Mississippi State-AID Seed Technology Contract the following services have been rendered both under the contract and in conjunction with the AFE, FE, LA and NESR Regional Programs. These are reported by contract periods.

March 18, 1958 - March 17, 1959

1. Technical consultation visit was made by Dr. Louis N. Wise to Paraguay in October and November, 1958, to review the seed improvement programs. Later, engineering blueprints, equipment lists and specifications for a seed processing plant and seed testing laboratory were prepared by appropriate specialists in the Seed Technology Laboratory and forwarded to Paraguay. The Paraguayan assignment was extended to include a consultation visit to Chile to plan a proposed Latin American Seed Training Course. Brief visits were also made to several other Central and South American countries enroute to and from Paraguay and Chile.

2. Two instructors, Dr. H. Dean Bunch and C. Hunter Andrews, and training materials were provided for the first Latin American Seed Testing and Processing Course, February 16 to March 13, 1959, at Chillan, Chile. The school was attended by 33 persons from 12 countries.

Following the school in Chile, a consultation visit was made by Dr. Bunch and Andrews to Buenos Aires to assist USOM/Argentina with plans and specifications for a seed processing plant and equipment. Subsequent follow-up assistance was provided.

On this same trip, consultation visits were made by Bunch and Andrews to Paraguay and Brazil to advise on seed processing, drying, and storage facilities. They also participated in and served as observers to the first week of the Second Latin American Seed Improvement Seminar in Lima, Peru, March 23 to April 3, 1959.

March 18, 1959 - March 17, 1960

Dr. Louis N. Wise served as AID/W consultant to the Second Far East Seed Improvement Workshop, Tokyo, May 11-29, 1959, financed with FE Regional Program funds.

Following the workshop, Dr. Wise visited Taiwan to review the seed improvement program and to determine type and amount of technical assistance needed. Plans were made for a two-month visit by Dr. Don Grabe of the Mississippi Seed Technology Laboratory on a specific advisory assignment on seed testing.

After leaving Taiwan, a consultation visit was made to Thailand to advise on USOM/Thailand's crop improvement project. Plans were discussed for the assignment of a seed testing specialist in an advisory capacity to the project.

2. Dr. Don F. Grabe, seed testing specialist, Mississippi State Seed Technology Laboratory, spent three months in Taiwan (June 27 - September 26, 1959) assisting with the development of a seed testing research, training, and regulatory program and with the seed certification project. Because of Taiwan's interest in becoming qualified for membership in the International Seed Testing Association, Dr. Grabe attended the meeting of this organization in Oslo before beginning the assignment. He held seminars on seed subjects in Thailand and Hawaii on the way to and from Taiwan.

3. Mr. Hunter Andrews spend an additional three months in Taiwan (August 24 - November 30, 1959) working with the seed research laboratory at National Taiwan University, the certification control laboratory at Taichung, and otherwise continuing the program begun by Dr. Grabe.
4. Assistance was provided on the planning and organization of the Second Latin American Seed Testing and Processing School in Chile. Many training materials were prepared for the school, and Dr. James C. Delouche, Hunter Andrews and Charles E. Vaughan served as instructors. The school was divided into two sections and held in Santiago (seed testing) and Chillan (seed processing), February 7 - 27, 1960. Twenty people from 5 countries attended the seed testing section of the school, while 23 people from 6 countries attended the seed processing section. A report on activities related to the school was prepared and submitted to ICA/W.

Consultation visits were made to Peru, Argentina, and Costa Rica on the way to and from Chile. Data were gathered for a seed processing plant in Costa Rica. Preliminary blueprints and equipment specifications were subsequently prepared and sent to Costa Rica by Mr. Welch and Mr. Vaughan.

March 18, 1960 - March 17, 1961

1. Dr. Louis N. Wise, serving as an AID/W consultant and financed with AFE Regional Program Funds, made a survey trip through 14 countries in Africa and Southern Europe to (1) determine the status of their seed improvement programs, (2) to explain the services available to them under the Mississippi State-AID Contract, and (3) to plan two future seed improvement seminars in the African area. He also attended the first part of the International Seed Trade Congress in Copenhagen.
2. Assistance was provided to JCRR/Taiwan on planning and preparation for the First Far East Seed Technology Training Course held at Taichung, Taiwan, August 29 - September 24, 1960. Many training materials were prepared and sent to Taiwan for the course. Dr. James C. Delouche and Hunter Andrews served as instructors. Eighteen technicians from 6 countries participated in the course. A report on the training course was prepared and submitted to AID/W.

- Dr. Delouche and Mr. Andrews spend approximately three additional weeks in Taiwan assisting with the seed research and certification programs.
3. Mr. Charles Vaughan returned to Costa Rica for approximately two weeks (August 17 - September 1, 1960) to assist with final plans for the seed drying and processing plant previously mentioned. Final blueprints and specifications have since been supplied by Welch and Vaughan and construction begun.
 4. Dr. H. Dean Bunch served as an AID/W consultant to the Third Pan American Seed Improvement Seminar, October 18 - 28, in Bogota, Colombia, financed with IA Regional Program Funds. Prior to and after the conference he traveled to Guatemala, Costa Rica, Panama, and Venezuela to advise on seed processing plants, cleaning equipment, seed increase programs and other matters relating to seed improvement programs in the individual countries.
 5. Dr. H. Dean Bunch was an AID/W consultant to the Third Far East Seed Improvement Workshop, January 30 - February 21, in Manila, Philippines, financed with FE Regional Program Funds. Following this conference he went to Taiwan, Thailand, and Indonesia to advise about hybrid corn programs, seed testing laboratories and seed technology programs.
 6. G. Burns Welch, Charles Vaughan, and Hunter Andrews drew up plans for a seed processing plant in Ghana based upon information received from that country by questionnaire. The plans were subsequently taken to Ghana by Dr. Bunch.
 7. (a) Compilation of information on various seed technology subjects and distribution to requesting missions.

Information was assembled, compiled and, in some instances, written on the subjects of (1) Foundation Seed, (2) Certification, (3) Seed Testing, (4) Seed Processing, (5) Seed Drying and Storage, (6) Seed Treatment, as well as on other related subjects closely allied to seed improvement. In addition, bulletins, articles, and reprints have been made available. It is approximated that close to 100 publications have been distributed to 30 missions. As a result of the recent Seed Seminar in Africa, approximately 500 publications are being prepared for distribution to 9 missions there.

- (b) Preparation of publications and other training material for use in country training courses.

Laboratory exercises concerning seed testing and seed cleaning were specially prepared for use in training courses held outside the U.S. In addition to these exercises, approximately 2400 copies of publications, including bulletins, compilations, articles and catalogs were distributed to 100 persons from 26 countries. In addition, about 500 copies of publications have been given to appropriate agencies in several countries for use in training schools for local farmers and seedsmen.

A considerable number of reference materials have also been sent direct to citizens of foreign countries as a result of their having heard of a source.

- (c) Collection and distribution of crop and weed seed for laboratory herbariums.

Over 500 species of crop and weed seeds have been supplied to two seed testing laboratories supported by USOM programs.

8. The following research project was initiated:

Seed in a packaging and storage test, involving three kinds of seed, three moisture contents, and four packaging materials, were shipped to Taiwan in May, 1960. These seed, totaling several hundred individual packages, will be stored under Taiwan conditions. Treatment effects will be evaluated monthly by the Seed Technology Laboratory at National Taiwan University.

Seed from a similar packaging and storage study have been shipped to Thailand and another is being prepared for the Philippines. The eventual objective is to locate one or more of these studies in each of the world's major climatic areas. Additional seed can be supplied for storage in all types of indigenous storage containers and facilities. Additional packaging materials can be provided so that local seeds and treatments may be included in the study.

If properly conducted and coordinated, these studies should benefit both the American Seed Trade and the seed and food programs of underdeveloped countries throughout the world. Specifically, the results of these studies should (1) enable

American seedsmen to provide better seeds and services to their overseas customers and, in turn, to demand and insure receipt of better seeds purchased from other countries, (2) provide AID with information needed to develop realistic shipment and storage specifications for seed purchased here or abroad, and (3) improve the quality of seed world-wide by enabling the individual farmer to safely store his crop seed from harvest until planting time.

March 18, 1961 - March 17, 1962

1. Dr. H. Dean Bunch served as an AID/W consultant to the First Crop (Seed) Improvement Seminar for Africa, Nairobi, Kenya, in June. Prior to the seminar he helped plan the program and assisted the local AID office in final preparations for the meeting. In addition to serving the seminar as technical advisor, he assisted Mr. Elton G. Nelson, Office of Food and Agriculture AID/W, in the preparation of the report of the seminar, since published.
2. Following the seminar, Dr. Bunch traveled to Ghana for consultation with the AID mission and members of the Ministry of Agriculture concerning plans for a seed processing plant and other aspects of the seed improvement program in Ghana.
3. Upon request of advisors and delegates attending the seed seminar in Nairobi, approximately 300 publications pertaining to the general area of seed improvement were sent to nine countries. A large part of these publications were especially prepared by the Mississippi Seed Technology Laboratory for use in the less developed countries.
4. As a result of Dr. Bunch's travel within Ghana and discussions of the existing situation and future plans of the Ghanaian Ministry of Agriculture in the area of seed improvement, it was agreed that the seed processing plant previously planned and blueprinted should be revised. Further, it was agreed that the Mississippi Seed Technology Laboratory would prepare specifications for buildings and equipment and obtain price quotations on the equipment. These requests are being met and the different phases are in varying stages of progress.
5. Contact has been maintained with Costa Rica relative to the progress of the seed processing plant designed earlier by the Mississippi Seed Technology Laboratory. It will be recalled that while Mr. Andrews and Mr. Vaughan were in Costa Rica

in February, 1960, they were requested to prepare and submit plans for such an installation. After the plans were drawn up, Mr. Vaughan returned the following August to Costa Rica to discuss the layout and to effect necessary changes. At the present time, a building has been completed and equipment is being shipped, about one-half of which has been received.

6. Upon request, suggestions on equipment and specifications for seed processing installations were made for Brazil, Peru and Taiwan.
7. A technique for ascertaining rapidly the viability of kenaf seed by the use of tetrazolium salts was developed for Guatemala. Detailed procedure for conducting the test and interpretation of the results were submitted.
8. The cooperative seed storage project with Taiwan was completed on May 15. This project was designed to measure the effects on seed of transoceanic shipment and subsequent storage under tropical conditions. Treatments involved 3 kinds of seeds (cabbage, soybeans, and wheat), 3 levels of seed moisture, and 4 types of packaging containers. The germination and vigor were tested at monthly intervals for one year of storage.

Similar projects initiated for Thailand included seeds of peanut, castor bean and corn, and for the Philippines, tomato, onion, and cauliflower seed. The seeds under test arrived in Thailand on July 3 and in the Philippines on August 2. A similar study in cooperation with Brazil is in preparation.

Data accumulated from these and similar tests should provide a basis for stipulating maximum levels of seed moisture content and types of packaging to be used on overseas seed shipments by AID or individual countries.

9. The exchange of correspondence and literature on the various areas of seed technology has been rather active with Germany, Sweden, Australia, New Zealand, Belgium and Holland. While it is recognized that these countries do not fall within the area of underdeveloped countries, this association is in part a result of the contract and tends to lend strength to the international effort for promoting the use of superior seed and improved methods through the dissemination of information.

10. In this same fringe area of activity the Laboratory recently sent a number of publications to a school in Mexico striving to build up its library.

March 18, 1962 - March 17, 1963

(Actual time covered, March 18 - December 31, 1962)

1. A series of pamphlets or bulletins are being prepared especially for leaders in seed improvement programs within the various countries. Our association with these people convinces us that the mechanics of getting things done must take high priority. The production, handling, processing, and distribution of high quality pure seed is a specialized business. Leaders need to know not only how to organize an effective seed improvement program but also how to handle the associated technological problems. For instance, how does one go about roguing a seed field? Or inspecting it? What does he look for? Such specialized information is not readily available through the medium of conventional government or state bulletins.
2. The cooperative seed storage research experiments are continuing with Thailand and the Philippines.
3. Dr. H. Dean Bunch had made preparations to serve as a consultant at a seed improvement seminar to be held in India in September, 1962. He further agreed to survey the countries of the Middle East on a mission for AID/W. He also agreed to visit several countries in Latin America, help work up an agenda for a Latin American seed seminar and to serve as consultant at this seminar. The fact that these plans did not materialize does not alter the fact that the existence of a working contractual agreement between AID and Mississippi State provides a pool of workers and facilities that can be made available practically on a moment's notice.
4. Direct inquiry of services available under this contract has been made in recent weeks. As a result we anticipate that AID/W will be asked to furnish the services of MSU for the design of a seed processing plant in Brazil for which we have sent equipment lists and specifications; to make a grain storage facility survey in Costa Rica; and to provide technical assistance on seed processing in Taiwan.
5. The revised plans for the processing plant in Ghana have been submitted to that country, bids on equipment have been let and all but a few miscellaneous items have been located.

6. The seed storage study with Thailand has been completed. Data have not been completely evaluated as of this date.
7. Design and drafting of a seed processing plant for Brazil has begun.
8. Preparation is underway for a member of the staff to go to Costa Rica early in January to consult on grain storage facilities.

Research: Several investigations in progress illustrate types of research that produce results directly applicable to problems in the less developed countries.

1. The relation between specific gravity of rice seed and the vigor of the rice seedlings is being studied by a student from the Far East. The objective of this study is to devise laboratory methods by which seed lots can be effectively evaluated, and thereby, provide a basis for eliminating low vigor seed lots from the nursery.
2. Seed storage is a problem the world over, particularly in tropical and sub-tropical regions in which many developing countries are located. Research is underway in the Mississippi Seed Technology Laboratory, much of it by international students under direction of staff members, directed at developing information on practical methods for preserving seed viability and vigor under adverse storage conditions. A solution to some of the many problems in this area would go far in furthering the use of improved seed and in preventing seed losses due to poor storage conditions.
3. Seed quality, particularly vigor, is important in the establishment of productive stands of vigorous seedlings. Investigations are under-way to develop methods for measuring vigor of seed lots before the seeds are planted. A uniform stand of vigorous seedlings would probably do as much toward increasing yield as any other one factor in many regions.
4. The study of maturation of seed in the field is another important project. Seeds already mature on the plant and waiting harvest can be affected adversely to varying degrees depending upon the kind of seed, the condition of the environment, the time and method of harvest, and associated factors. Experimental work under-way is directed toward ascertaining the individual and accumulated effect of the

factors involved in deterioration of seed in the field and means of preventing or minimizing such effects. Results from such research should have wide application.

Training: As a consequence of the complete and unique seed training program at Mississippi State University and emphasis on training of foreign participants within and outside the United States under the contract, increasing numbers of foreign students come to MSU to study various aspects of seed technology. At the present time students from seven countries are regular students working toward either a B.S. or M.S. degree with a major in Agronomy-Seed Technology. Some of these students are sent by AID, several are on MSU assistantships and some are sent directly by their governments. It is hoped that they will return to their countries and become leaders in seed testing, seed processing, and seed improvement.

March 18, 1963 - March 17, 1964

(Actual time covered, January 1 - December 19, 1963)

At the request of the USAID/Costa Rica Dr. H. D. Bunch went to that country to advise on a grain storage program. Specifically, an agency of the Costa Rican government wanted technical assistance in preliminary planning of a million-bushel facility for drying, storage and distribution of grain. As a result of this visit the Seed Technology Laboratory agreed to design, prepare preliminary engineering drawings, and write specifications for the facility.

In July, Dr. Bunch served the Fourth Pan American Seed Seminar in Brazil as consultant and advisor representing the United States. He was accompanied by two commercial seedsmen who stayed in Brazil after the Seminar and served with Dr. Bunch as a team that reviewed the seed programs in Brazil. As a result of this review, the team submitted a proposed program which should serve as a guide to any technical assistance group planning to initiate seed improvement programs in a country.

Enroute to Brazil Dr. Bunch stopped in Costa Rica to confer with the mission and other interested parties on the grain storage facility and to report progress on the planning.

3. Charles E. Vaughan served as a consultant in seed processing to the Joint Commission for Rural Reconstruction in Taiwan during August and September. The objectives of this assignment were:

- (a) To suggest ways and means for improving seed processing and storage on the farm.
- (b) To suggest improvements in operations and maintenance of seed processing plants operated by agencies of the local government.
- (c) To advise on research concerned with the development of seed processing methods adapted to local conditions.
- (d) To conduct a training course for local technicians on seed processing, packaging, storage and handling.

Most of these objectives were accomplished during the time Mr. Vaughan was in Taiwan.

4. In August, George M. Dougherty went to Vietnam to advise USAID and cooperating agencies on organization of a seed improvement program. Problems of low farm income, low level of education among farmers, limited facilities, and a lack of trained workers are magnified in Vietnam by the national emergency. While not a solution for all agricultural problems, the general use of good seed is an effective way to increase food supplies. Mr. Dougherty's role was one of advising on the administration of a seed distribution program and on the improvement of laboratory techniques.

After leaving Vietnam in early September, Mr. Dougherty went to Taiwan to continue for a month work suggested by Mr. Vaughan, specific objectives were:

- (a) To assist JCRR engineers in design and construction of a multi-crop threshing unit for use on small farms.
- (b) To recommend methods of improving seed storage facilities.
- (c) To assist persons working on the vegetable seed export program.

Reports on the assignments described here were prepared and distributed to the appropriate agencies through the contract office or directly to the individual countries upon notification of the contracting officer.

5. During the year a bulletin, "The Tetrazolium Test for Seed Viability", Miss. Agr. Exp. Sta. Technical Bulletin 51, was widely distributed. This bulletin, based on research at the Seed Technology Laboratory and presented in a handbook style, describes methods of use and evaluation of a type of seed testing which should be very useful to technicians engaged in seed improvement programs. After announcement by AID that the bulletin was available, requests resulted in a first shipment as follows: AFE (French speaking countries), 102 copies; AFE (English speaking countries), 72; Far East, 48; Near East and South Asia, 60, and Latin America, 75 copies. Many more have been sent to various persons overseas since this first shipment.
6. Over 1000 booklets, bulletins, and handbooks on various phases of seed technology and seed improvement were distributed to six Latin American countries through USAID missions. The request for these materials stemmed directly from the Fourth Pan American Seminar and indicates to some extent the interest in seed improvement in these countries.
7. The plans of the seed processing plant for Ghana have been submitted in final form and the Seed Technology Laboratory is prepared to assist Ghana in securing bids, selection of equipment or any other way which will implement the plans for the processing facility.
8. Three seed processing facilities were designed for different locations in Brazil.

A relatively simple plant was designed for use by the Brazilian government at its inspection stations in the state of Rio Grande do Sul. Drawings were prepared and equipment requirements determined. Efficiency and low cost were the prime requisites for this installation.

A foundation seed processing plant was designed for a University in Vicosa, Minas Gerais. Here the simplest equipment consistent with satisfactory performance, was chosen to facilitate the cleaning of machinery in order to prevent varietal mixtures at this stage in the seed

multiplication program. Plans were drawn, specifications written, and competitive quotations on equipment were received and transmitted to the interested agency. Items of equipment were also recommended for a small vegetable seed processing plant at this same location.

A commercial-size seed processing plant complete with unloading facilities, artificial dryer, a modern conveying system, and up-to-date equipment was designed for the Ministry of Agriculture in Pelotas, Rio Grande do Sul, to fit specific needs as outlined by the Agency that will operate the facility. The design developed is for a modern installation, but nothing superfluous was included. Plans were drawn, specifications written, and suggestions made for building a portion of the plant as the basic unit if funds were not immediately available for the entire facility. The Seed Technology Laboratory has also offered to advertise for bids if requested.

9. It was indicated in earlier reports that research projects were underway in cooperation with Taiwan, Thailand and the Philippines. In these experiments three kinds of seed (the kinds differing in each country) were adjusted to three moisture levels, packed in four types of containers and shipped in the same manner as normal ocean freight. Cooperating laboratories in each country tested the seed from the several treatments at monthly intervals for viability and vigor, reporting the data to the Mississippi Seed Technology Laboratory. The results on the effects of seed moisture level and type of packing containers used in transporting and storing the seed have been compiled, summarized, prepared for use of the cooperators and others interested in this type of work. Reports have been sent to the AID/W and to the missions and cooperators in the three countries.

A similar study was initiated during the year in cooperation with Costa Rica; only rice was used in this experiment.

General: The activities described above received major attention. Other more or less routine matters took both time and effort. Such matters, as advising on particular aspects of the seed program in Morocco, making suggestions on teaching seed technology courses in India, providing samples of tetrazolium to interested countries, sending information materials all over the world and, in general, keeping in contact with persons working on seed problems in the several countries where acquaintances and friendships have been established.

It may be noted that the major services the past year were performed in Latin America and in the Far East. Several reasons may be advanced for the accelerated activity in these regions. The USAID Missions and local technicians are very familiar with services available under AID-W-607. It is very likely that many USAID Missions in other regions do not know the nature and extent of services available under the contract. With the authorization of AID/W, the Seed Technology Laboratory would be happy to assist in the preparation of an airgram, to be addressed to all Missions, describing types of services that the missions could request under the contractual agreement.

March 13, 1964 - March 17, 1965

(Actual time covered, January 1 - December 31, 1964)

1. Preliminary engineering drawings and complete building and equipment specifications for a 1/2 million bushel grain elevator and bagged storage warehouse for Costa Rica were completed in June, 1964. This project was initiated in 1963 and involved preparation of 7 drawings covering plant perspective, flow diagrams, floor plans and general elevation, bin layout and section elevations of the elevator, storage bins and warehouse. Complete specifications of all mechanical equipment were prepared in detail; general specifications for construction and concrete work were also prepared. Cost of the facility was estimated at U.S. \$826,000. The completed plans were submitted to AID/W and USAID/Costa Rica for transmittal to the Consejo Nacional de Produccion de Costa Rica.
2. On request from Morocco (TOAID A-551) the design and equipment and building specifications for a seed processing facility for the National Institute of Agricultural Research, Rabat, were developed. The completed plans and specifications were forwarded to AID/W and USAID/Morocco for transmittal to the appropriate agency in Morocco.
3. Dr. James C. Delouche served as a consultant specialist in seed testing and seed control to the Mississippi State University AID/la-165 Brazil contract from October 17 through November 29. During the period October 19 to November 7, he reviewed the programs of several seed testing laboratories, gave instruction in a Brazilian seed improvement course, and participated in a conference on national seed legislation with delegates from the Ministry of Agriculture, and the states of Sao Paulo and Rio Grande do Sul. From November 9 - 27, Dr. Delouche served as one of the instructors in the "Seed

Improvement Training Course for Latin America and Caribbean Area" in Campinas, S. P., Brazil, sponsored by the International Seed Testing Association, Mississippi State University, and the Agency for International Development. Forty seed specialists from 8 countries participated in the training course.

4. At the request and expense of the Venezuelan government, James M. Beck, Engineering Technician on the Seed Technology Laboratory staff, served as consultant to the Venezuelan Seed Service, Maracay, Venezuela, from October 24 to November 4. In Venezuela, Mr. Beck inspected facilities and determined immediate and future needs. Upon his return to Mississippi State, detailed drawings and equipment specifications were prepared and sent to Venezuela.
5. At the request of the AID and IAS, the Mississippi Seed Technology Laboratory planned and conducted a four week special course in seed improvement for a four man Moroccan group during the period October 19 to November 6, 1964. This special course included three weeks of classroom and laboratory work and a one-week study tour of seed plants in Mississippi and Louisiana.
6. The cooperative seed storage, shipping and packaging study with USAID/Costa Rica and the Consejo Nacional de Produccion de Costa Rica on rice seed was completed. Rice seed were adjusted to six moisture contents, and packaged in five types of packaging material at the Mississippi Seed Technology Laboratory in August, 1963. The seeds were then shipped via surface to Costa Rica. In Costa Rica germination and moisture tests were made on the seeds at monthly intervals for a twelve month period. Data collected in Costa Rica were forwarded to the Seed Technology Laboratory by USAID/Costa Rica in November, 1964. The data are presently being analyzed and a summary prepared for interested agencies.
7. Work was undertaken on the design of an inexpensive seed germinator for developing countries. The design involves incorporation of an inexpensive heating element and accurate thermostat into a water reservoir built into an old refrigerator body or other insulated chamber. The design has been made available to the Mississippi State University AID/la-165 Brazil Contract for trial and field testing in Brazil.

8. Many requests from AID and University Contract/AID personnel stationed in various countries to the Seed Technology Laboratory for information on seed drying and seed dryers have resulted in an increase in the laboratory's activity in this area. A prototype seed dryer for small experimental seed lots and vegetable seeds was designed and developed. Although the prototype dryer has given generally satisfactory results, some components are being modified and redesigned to provide for more precise temperature control and increased uniformity of static pressure and temperature within the drying system. This will be important for thermal-sensitive vegetable seed such as onions. The dryer design will not be released until redesign has been completed and more extensive tests have been made.
9. In cooperation with an AID sponsored graduate student from Vietnam, a method for breaking seed dormancy in rice was developed. The results of this investigation are being published in a technical journal.
10. Assistance was provided and instructive materials sent to New Zealand for a Far East Seed Improvement Training Course held there from November 9 - 27 under sponsorship of the International Seed Testing Association and the New Zealand government.

General: Major activities during the year were described above. Other activities of a routine nature took both time and effort. Such activities included answering many questions and providing information by mail to AID personnel, agricultural attaches, field men of the Ford and Rockefeller Foundations, and many former students of the various training programs. This activity - providing advice and information via correspondence - has increased to the extent that it is presently of major importance. Requests for advice and information are not limited to types of persons indicated above - many requests come from persons, agencies and firms who have heard about the Seed Technology Laboratory from a fellow countryman who might have visited it or been a student here. These activities are encouraged because they provide an excellent means of maintaining contact, of follow-through on various matters, and of solving problems of a routine nature.

Another major activity of the laboratory was the annual Seed Improvement Course sponsored by AID and IADS. Eight persons from four countries participated in the five-week portion of the course held at MSU from June 15 - July 1, 1964.

The laboratory also provided major support in terms of organization, planning, supplies and equipment for the "International Seed Training Course on Seed Improvement for Latin America and Caribbean Area" held in Campinas, Brazil, November 9 - 27, in addition to providing an instructor.

March 18, 1965 - March 17, 1966

(Actual time covered, January 1 - December 31, 1965)

1. Data from the cooperative rice seed shipping-storage project were analyzed and a summary report of the results was prepared and sent to AID/W and cooperating and interested agencies. Results indicated that at seed moisture contents of 8.9, 10.3, and 11.0, tin cans, polyethelene-aluminum inserts, and .010 gauge polyethylene bags-heat sealed, were superior to .010 gauge polyethelene bags-sewn and cloth bags in maintaining germination and vigor of rice seed during oceanic shipment and subsequent storage in Costa Rica. Seed deterioration of rice was rapid at moisture contents of 12.2, 13.3, and 14.3 percent, regardless of type of storage container. For successful oceanic shipment of rice seed to and subsequent storage in countries of Latin America, it is recommended that rice seed be packaged at moisture contents of not more than 10 percent in properly sealed moisture vapor-proof containers.
2. The design and testing of an inexpensive germinator for use in developing countries has continued. In addition to the design incorporating a submersible heating element and thermostatic controls in an old refrigerator body, a larger, walk-in type chamber, capable of maintaining temperatures below ambient is under development. This design incorporates a standard window air-conditioner, and small electric space heaters for cooling and heating. Heating and cooling elements are wired in series to two thermostatic controls so that the desired temperature is maintained within 1° C. Addition of a timing device and two more thermostats allows automatic alternation of temperatures between high and low levels. This is necessary for the germination testing of many kinds of seed. A two-ton air conditioner fitted with air plenum chamber and electrically activated and powered valves, is sufficient for three rooms (walk-in type) of 6' x 10'. All materials and equipment except timer, thermostats, and valve motors are generally available in the developing countries. Cost is only a fraction of that of "packaged" equipment. After further testing and development of means for preventing excessive drying of moist germination media, specifications,

detailed drawings, and operating instructions for the system will be prepared and made available to AID/Washington for distribution in developing countries.

3. Development of the prototype seed dryer reported for the last period has been completed. Solid-state, modulating controls permit extremely accurate control of the temperature of the air entering the seed bins. Evaluations indicate that the dryer is very effective. Redesign is progressing to minimize costs and increase capacity. Toward this objective, an entirely new design was developed in cooperation with the Agronomy Department, Mississippi State University, and a private designer (at no cost to AID-W-607). Operation of a pilot model of the new dryer has revealed several flaws in design which are being corrected. The dryer has the built-in versatility desirable for handling breeder's and foundation seed. Bin, drawer, and sack drying can be accomplished in the same system at the same time.
4. A cooperative seed storage and packaging study was initiated with the Owens-Illinois Corporation. Corn, wheat and soybeans were packaged at several moisture contents in five thickness gauges of polyethylene bags, multiwall paper bags, and cloth bags. After packaging the seeds were stored in Owens-Illinois's "tropical room" maintained at 85° F, and 85 percent relative humidity. Moisture contents, germination percentages, and vigor tests are being made at intervals. This study supplements those involving transoceanic shipment to countries in the Far East or Central America. It should provide more dependable and accurate information as all phases of the work are being conducted by experienced researchers of the Seed Technology Laboratory. In the other studies, quality evaluations were made by technicians in cooperating countries and considerable variability in results was noted. This can be attributed to a lack of experience of technicians in cooperating countries.
5. On the request of AID/W, Dean L. N. Wise and Dr. James C. Delouche met with Dr. Frank Parker (AID/W) and TVA officials on August 11, 1965, to (a) review procedures used by TVA on a survey of world fertilizer needs and resources, and (b) discuss the feasibility of a similar survey on world seed needs and resources. Subsequent to this meeting a preliminary draft of a proposal for a seed survey was submitted for review to AID/W. Initial concept of the proposal was to incorporate it as an amendment to the Mississippi State University AID-W-607 agreement. The most recent consideration, however, is to treat the seed survey under a

separate research agreement. Contact with AID/W is being maintained through final considerations and revisions of the proposal.

6. James M. Beck served as consultant to the Mississippi State University AID/1a-165 Brazil contract from August 26 to November 23, 1965. Mr. Beck consulted with and advised contract party on seed storage and seed processing. While in Brazil, he inspected and analyzed several unique seed drying and storage installations as to their applicability to other developing countries.
7. At the request of AID/Honduras and on approval from AID/W, Dr. James C. Delouche visited in Honduras with AID and DESURRAL officials during the period September 17 to October 1, 1965. A proposed 5 year program for seed improvement in Honduras was reviewed and existing facilities were inspected. On return to Mississippi State University, work on planning, design, equipping, and specifications for facilities required to meet Honduras's seed production goals for 1970 were initiated.

These facilities include: (a) temperature and humidity controlled seed storage for 10,000 qq. (cwt.) corn and rice (San Pedro Sula) and 12,000 (cwt.) beans and sorghum (Tegucigalpa), and unconditioned storage for 10,000 qq. (cwt.) corn (San Pedro Sula); (b) ear corn drying and shelling facilities (San Pedro) with capacity of about 500 qq. per 10 hr. day, and a drying and temporary storage facility for 5000 qq. rice; (c) corn and rice seed processing, conveying and grading facility (San Pedro Sula) with capacity of 500 qq. per 10 hr. day; (d) processing facility for 8000 qq. beans and sorghum (Tegucigalpa); and (e) a plan for operation of the facilities. This work is in progress. Designs and specifications for the conditioned and unconditioned storage warehouses are complete and have been sent to AID/Honduras. The design and specifications of the seed drying, processing and office-laboratory facility for San Pedro Sula are nearing completion. The seed processing and office facility for Tegucigalpa is in the preliminary planning stage. It is anticipated that on completion of all designs and specifications, a member of the staff will be requested to go to Honduras to discuss entire plant with AID and DESURRAL personnel and prospective contractors.

The facilities are estimated to cost the equivalent of approximately U.S. \$300,000.

General: The activities enumerated above received major attention. Other activities handled on an informal basis required considerable time and attention. Among these were:

- (1) Submission of blueprints and further explanation to potential suppliers for the Morocco seed processing installation designed earlier.
- (2) Preparation of specifications for seed testing equipment for the government seed testing laboratory in Santiago, Chile.
- (3) Preparation of flow diagrams and details on procedures and types of equipment needed for grading corn and processing seed for Gross Equipment Co., Lima, Peru (referred to us by personnel of North Carolina State/AID contract with Peru).
- (4) Organization of a 5 day "refresher" course for Mr. W. C. Davis, Agronomy Advisor, AID-Pakistan, for the period August 16 - 20, 1965. Subsequent to Mr. Davis's departure, teaching materials, slides, and other reference materials were collected and forwarded to USAID/Pakistan.
- (5) Discussion of seed processing problems, training courses, and organization of seed improvement programs with Jack Traywick, Agricultural Engineer, Rockefeller Foundation-India, during his home leave (August 11 - 13, 1965). Subsequent to Mr. Traywick's departure, colored slides illustrating seed equipment were made for the India program, and lecture notes on various seed courses taught at MSU were photocopied for use in training courses in India. During the year several large packages of other reference and instructive material were also sent to India.
- (6) Reference materials on seed improvement were selected, obtained, and shipped to Colorado State University for use in work under their Nigeria contract.
- (7) Advice and specifications for color separations of sesame seed were sent to USAID/Sudan.
- (8) Data on and procedures for storage of vegetable seed were provided a farmer in Chile, a seed company in India, and several U.S. companies engaged in seed export operations.

- (9) Seven days instruction on tetrazolium testing and evaluations for seed mechanical damage were given to an agronomist-technician from Salvador, Central America.
- (10) The 10th Annual Seed Improvement Training Course under sponsorship of IADS (USDA) and AID was conducted by the Seed Technology Laboratory from June 14 to July 16, 1965. Fourteen participants from six countries were enrolled in the five week course. A staff member of the Seed Technology Laboratory served as technical leader to the group during the five week tour of seed companies, seed improvement associations, etc., in the Midwest and South that constitutes the second part of the Seed Improvement Training Course.

During the year, the laboratory also sent reference material to agricultural libraries and individuals in many countries, and answered many routine inquiries.

Training: In addition to the training activities reported above, international students from seven countries (India - 1, Pakistan - 1, Philippines - 2, Iran - 1, Brazil - 3, Thailand - 2, Korea - 1) were enrolled as graduate students in Agronomy-Seed Technology during the past year.

Plans for 1966-67: Requests for services under the AID-W-607 agreement are not programmed and, therefore, cannot be anticipated. The current Honduran project will require services under the contract at intervals over the next several years. Since this is a completely new program and experience for Honduras, they will need on-the-spot advice and help prior to construction of the facilities, after construction of facilities to arrange and install equipment, and during at least one processing season (3-4 weeks) to instruct Honduran technicians in operation of facilities. It is also anticipated that instruction in plant operation will be required when the Moroccan plant is completed. Informal contact also indicates probable need for services in Chile and possibly India.

The staff of the Seed Technology Laboratory is not idle between assignments to countries. They continue to research on practical and realistic designs, techniques and procedures to meet the needs of seed improvement programs in developing countries.

Current plans involve (1) preparation of a handbook on seed plant design based on the many facilities designed in the past, (2) revision of reference handbooks on seed improvement programs, seed processing and handling, and seed storage. These handbooks will incorporate experiences and information gained over the years and replace collections of materials previously available.

Research will continue on seed storage and drying. These two areas comprise the most difficult and complex seed problems in developing countries. Most of the countries are in tropical or subtropical regions and have incredibly adverse environments (high humidities and temperatures) during a major part of the year. Since the technology of seed drying and storage has evolved around the comparatively mild conditions of the U.S.'s grain belt and Northwestern Europe, it is not always directly applicable to tropical or subtropical environments.

March 18, 1966 - March 17, 1967

(Actual period covered January 1, 1966 - March 1, 1967)

1. Work started in October, 1965, on the designs and specifications of facilities for the seed program in Honduras was continued through most of the year. Sections of the plans were forwarded to USAID/Honduras as they were completed. All major segments were complete by May, 1966; however, modifications and revisions of and additions to the plans have continued to the present time. Assistance provided USAID/Honduras involved the development and preparation of plans, designs, and specifications for "seed plants" to be located at San Pedro Sula and Tegucigalpa. Items incorporated in the plans included: (a) conditioned seed storage warehouses; (b) open storage warehouses; (c) dryers for bean, rice and corn seed; (d) a low temperature room for storage of breeder and basic seed; (e) a testing laboratory; and (f) two processing plants with attached offices. The plans were developed in considerable detail - down to technical specifications on all equipment for use by GSA and complete wiring diagrams for the facilities. The facility located at the San Pedro Sula site is nearing completion. Principal sections of the plans developed were collected into a single report which was filed with AID/W and USAID/Honduras.

2. At the request of USAID/Panama and on approval from AID/W Dr. G. Burns Welch, Agricultural Engineer, and Mr. B. R. Gregg, Seed Technologist, served as consultants to USAID/Panama during the period April 4 - 14, 1966. Assistance and advice were provided to USAID/Panama on the Panama Accelerated Seed Program. Specific purposes of the visit were: (a) to examine all existing seed processing facilities in Panama, including those of MACI and those recently transferred to IFE, to determine their adequacy in temperature and humidity controls and handling and storage capabilities; (b) to discuss and advise on a

proposed revolving fund, including terms, management, etc.; (c) to advise and assist in determining present and projected seed needs by type required for the accelerated agricultural productivity program. These purposes were accomplished and a Summary Report was submitted to AID/W and USAID/Panama. A more comprehensive report was prepared at a later date and forwarded to AID/W.

3. Dr. G. Burns Welch returned to Panama for consultation during the period August 15 - September 6, 1966. The purposes of this visit were to advise and assist USAID/Panama and the GOP in installing pure seed processing equipment procured and delivered as a result of recommendations made by Dr. Welch and Mr. Gregg during their April, 1966, visit. Dr. Welch designed the layout of the Divisa seed facility, marked location of all equipment in plant, designed surge bins, dust collectors and structural supports for all equipment, supervised their construction, and assisted with the installation of machines and accessory equipment. Mr. B. R. Gregg traveled to Panama with Dr. Welch and assisted with the work there during the period August 15 to August 23. Gregg's services and travel were at the expense of Mississippi State University.
4. After leaving Dr. Welch in Panama on August 23, Mr. Gregg stopped over for informal visits in Costa Rica (8/24 to 8/26), Honduras (8/27 to 9/1) and Guatemala (9/1 to 9/4) on his way home. USAID personnel, local officials and technicians, and commercial seedsmen in each country were most enthusiastic and cooperative. During these brief visits to the three countries, Mr. Gregg (a) reviewed recent developments in the Costa Rican seed program, (b) discussed the progress of work on seed facilities designed for Honduras with USAID/Honduras; (c) discussed training methods and needs in seed technology with the Director and Faculty of the Escuela Agrícola Panamericana at Zamorano (Honduras); and (d) reviewed progress and needs of the Guatemala seed program with USAID/Guatemala personnel, local technicians, and Billy S. Barnes, Rice Improvement Specialist from Mississippi State University stationed in Guatemala under Contract AID/1a-408 Guatemala. A report of Gregg's informal visits in Central America was prepared and submitted to AID/W.
5. At the request of USAID/Panama, Mr. B. R. Gregg left on February 13, 1967, for an assignment of approximately 6 weeks in Panama. The purposes of this visit are to follow-up

the work initiated during the April and August-September visits. Specifically, he will provide the technical assistance and supervision needed to initiate operation of the pure seed center and pure seed program and to train five Panamanian technicians to operate the facilities. A report on this assignment will be submitted to AID/W after Mr. Gregg's return from Panama.

6. Our work over the past several years with technicians from many countries suggests that general - but detailed - information on facility and equipment requirements for a seed improvement program is badly needed. Concepts and ideas as to the nature of these requirements are usually vague and uncertain. As a consequence, both short and long range planning of seed improvement programs suffer because adequate and satisfactory provisions are not made for "handling" of the seed in the quantities projected. Inadequate, unsatisfactory and/or unbalanced plans result in poorly organized, inefficient and ineffective programs. Built-in deficiencies and imbalances cannot be easily or soon corrected. Dr. Welch and Mr. Gregg discussed these needs and problems with USAID personnel, local officials and commercial people in Central America this past year. Out of these discussions and discussions among our staff, the idea of developing "generalized" or model plans for a complete seed improvement facility was conceived.

Generalized or model plans would: (a) orient planners and technicians with respect to the many considerations and factors involved in planning for seed improvement facilities; (b) provide information on the several operations involved in seed processing and handling and the types of equipment required; (c) serve as a guide or model for developing plans; and (d) provide a basis for developing preliminary equipment and facility lists and budget estimates. The development of generalized or model plans that would assist in the ways indicated above was begun in late fall, 1966. A preliminary draft of the "processing plant" section was prepared for staff study. Review of this draft indicated that the plans needed to be expanded to include drying and storage units and that more information, diagrams and other illustrative material needed to be incorporated. Work on the plans will continue. It is anticipated that a final draft will be ready for review by ARDS/AID in summer, 1967. It is of interest that the preliminary plans coincided with needs in Guatemala so well that copies have been sent to USAID/Guatemala for use in planning.

7. The design and evaluation work of low-cost controlled temperature rooms ("walk-in germinators") for use in the less developed countries has been completed. Principal mechanical features of the design include a standard window-type air conditioner (cooling), electric space heaters (heating), a small fan and timing devices. The heating and cooling elements are wired in series to thermostatic controls and timing devices so that any desired constant or alternating temperature between 16° and 40° C. can be maintained with an accuracy of $\pm 1^\circ$ C. A pamphlet containing specifications for the controlled temperature rooms, and a discussion of their operation and possible uses has been prepared. After review of the pamphlet and design by AID/W it will be reproduced and distributed in the various countries.
8. The "tropical environment" seed storage and packaging study initiated in late 1965 in cooperation with the Owens-Illinois Corporation has continued into its second year. This study was designed to evaluate the relative effectiveness of seed packaging materials (plastics, multiwall kraft paper, and cloth) in preserving seed viability under tropical conditions (85° F. and 85% relative humidity). Considerable data have been collected but they will not be analyzed and summarized until December, 1967, the end of the second year. (The study is designed to run 4 years).
9. Work has continued on the development of a small prototype seed dryer for basic seed production programs in the less developed countries. Necessary re-design is in progress to simplify the control system, reduce costs, and provide for a more uniform distribution of air to the drawer, sack, and bin sections of the dryer.
10. Preparation of a comprehensive illustrated handbook on "Seed Processing and Handling" was completed. This handbook was prepared primarily for use by technicians in the less developed countries and in training activities under AID W-607. An attempt was made to present fundamental principles in detail and to relate these principles to the specific types of seed processing equipment available. The handbook has been reviewed by ARDS/AID and suggestions made are being incorporated. A "pre-print" of the handbook will be submitted to ARDS/AID for final review before publication.

General: The activities enumerated above received major attention. Other activities during the year were of a routine, informal and/or indirect nature but required considerable attention.

Among these were:

- (1) Substantial assistance to the Texas A & M M/AID contract in the Dominican Republic on design and layout of a seed processing plant and seed testing laboratory.
- (2) Assistance to the Ohio State/AID contract in India on requirements for a seed testing laboratory.
- (3) Periodic assistance to H. W. Byrd, Purdue Fellow in Latin America assigned in Brazil to the Agroceres Corn Seed Company, on quality control and storage.
- (4) Assistance to the Rockefeller Foundation seed specialist in India on teaching materials and seed testing.
- (5) Review of plans and specifications for improvement of facilities for the seed program in Costa Rica.
- (6) Preparation of informational material on seed testing laboratories for Universidad Agraria, La Molina, Peru.
- (7) Orientation of and conferences with visitors.
 - (a) Prof. Fernando Filguenro, 4/4 to 4/8 (Purdue/AID Brazil Contract)
 - (b) Victor W. Calderon, 4/25 - 4/29 (Costa Rica)
 - (c) Johnson E. Douglas, 7/11 - 7/15 (Rockefeller Foundation/India, formerly USAID/India)
 - (d) R. Norton Ford, 7/25 - 8/1 (Ford Foundation/India)
 - (e) Mayo Vega, 8/30 - 8/31 (AID/Nicaragua)
 - (f) N. T. Commack and C. S. Woodring, 10/24 - 10/27 (USAID/Nepal)
 - (g) W. T. Harris, 11/7 - 11/11 (USAID/Afghanistan)
 - (h) Yookti Sarikaphuti, 1/3 - 1/6 (Thailand)
- (8) The 11th Seed Improvement Course for international participants under sponsorship of AID and IADS (USDA) was conducted by the Seed Technology Laboratory during the period June 13 to July 16, 1966. Ten participants from Ghana (6), Morocco (1), Cambodia (1), Guyana (1), and Iran (1) were enrolled in the five week course. Following the five week period of intensive study, the participants went on a five week tour of seed companies, experiment stations, seed improvement associations, etc., in the Midwest and Southwest.

Services performed under the AID/MSU Seed Technology contract are "backstopped" by the comprehensive research and training programs of the Agricultural Experiment Station and the University. These programs - financed by Federal, State and Grant funds - are concerned with many of the same problems found in the developing countries, for the climatic conditions and agricultural cropping patterns in Mississippi are similar to those in many of the less developed countries. The program has been kept realistic and practical in its approach to world seed problems through a long and active training program in seed technology for international students.

Training (See Appendix IV for complete listing of international students)

Since 1956, Mississippi State University through its Seed Technology Laboratory, has provided the major part of the leadership, instruction, and facilities for an annual IADS/AID sponsored Seed Improvement Short Course. This short course is held each summer over a 10 week period. During the first 5 weeks of the course, the participants are given basic classroom, laboratory and practical instruction in seed testing, treating, processing, drying, storage, legislation, marketing, and certification. Following this intensive training period, the students tour four to five states through the central part of the country for 5 weeks observing the variations and patterns of seed improvement in the different areas. They then return to MSU for a final few days before departing for study elsewhere or home. While this annual seed improvement course is not an integral part of the MSU/AID contract, the contract has enabled the Seed Technology Laboratory to expand its staff so that full attention can be given to this activity. Upon their return home, many of the participants continue to request advice and counsel from the staff on seed improvement problems. Since 139 persons from about 38 countries have participated in the course, a rather voluminous technical correspondence has developed which can only be justified on the basis of the AID/MSU contract.

In addition to specialized short courses, Mississippi State University, through the Seed Technology Laboratory, attracts an increasing number of international students interested in undergraduate, graduate, or special (non-degree) study programs in Agronomy-Seed Technology. These students are variously supported by AID, the Rockefeller Foundation, or by graduate assistantships from Mississippi State University. Each year several graduate assistantships are offered to outstanding international students for M.S. degree programs.

Another important way in which the contract has helped is in the attention that can be and is given to participants on study tours sent by AID to the laboratory throughout the year. Inasmuch as AID has in effect engaged the services of the entire staff, nationals or AID personnel

Related Activities: Dr. J. C. Delouche served as a consultant to the Ford Foundation program in India during the period March 13 - 31. In India, he reviewed the IADP rice seed program and other seed programs under Ford Foundation sponsorship. On his return, Mississippi State University undertook the responsibility for locating a suitable rice seed specialist for the Ford program in India. R. Norton Ford, Panhandle College, Oklahoma, was employed by Ford Foundation in late July, 1966, and is now in India.

Dr. J. D. Helmer presented an invitational paper to the Proyecto Cooperativo Centroamericano para el Mejoramiento de Cultivos Alimenticios meeting (March 28 - April 1) at Managua, Nicaragua, on "Formation and Development of a Seed Certification Program". He also visited in Honduras after the meeting.

In cooperation with the MSU's AID/Brazil contract team, and AID/W, the Seed Technology Laboratory organized and conducted a Seed Industry Development Program for 23 Brazilian participants during the period September 27 to November 11. The tour covered nearly 6000 miles with stops in 9 states and Washington, D. C. Programs were arranged at 4 Universities and experiment stations, USDA agencies, 13 commercial seed companies ranging from a small seed grower to a giant hybrid seed company, and 2 equipment manufacturing companies.

BACKSTOPPING

Facilities and Staff (See Appendix I for complete listing of Staff)

Under this contract, the Agency for International Development has available to it the specialized and unique staff and facilities of the Mississippi Seed Technology Laboratory. Collectively, the staff represents a high level of competence and experience in all aspects of seed improvement: seed legislation, certification, processing, testing, storage, drying, production and research. Individually, members of the staff by training and current responsibility specialize in one or more of the various areas. The facilities and equipment of the laboratory include a particularly wide array of seed processing, conveying and treating equipment, a well-equipped seed testing laboratory, controlled temperature and humidity seed storage rooms, and the other equipment and facilities required for a comprehensive seed research, training and service program. The location on the same campus of the Mississippi Seed Regulatory Laboratory, the Mississippi Foundation Seed Program (both supervised by members of the Seed Technology Laboratory staff), and the Mississippi Seed Improvement Association (certification agency) insures the maintenance of a high - but practical - level of staff experience and competency in all areas of seed improvement.

train develop into leaders of seed improvement in the various countries. For example, four Brazilian specialists are conducting several three-week courses in seed improvement each year for workers in their country. These four specialists received a major part of their training under activities of the AID/MSU contract, and their course organization and instructive materials are the same as those used in their own training.

It also appears significant that in the past few years, Peru, Chile, the Philippines, Taiwan, and Mexico, have been admitted to the International Seed Testing Association. These first four countries (and Mexico under Rockefeller sponsorship) have all received more than average amounts of assistance under the contract in the area of seed testing and each have sound, if not complete, seed improvement programs.

In March, 1964, a separate contract was concluded between Mississippi State University and Aid for Brazil. Under terms of that contract (AID/1a-165 Brazil) and subsequent amendments, a five man team from the Seed Technology Laboratory is stationed in Brazil for two year periods to help develop a seed improvement program for that vast and important country. More recently, a rice improvement specialist from the laboratory was stationed in Guatemala under contract AID/1a-408 Guatemala. Certainly these individual country contracts were a result of the accomplishments of the global contract. These contracts, in turn, provide support to the global contract. For successful developments in the field can be immediately translated into recommendations for dissemination to other countries.

PLANS AND PROJECTIONS

Future activities will be largely determined by operational policies specified by AID/W, and requests initiated in USAID Missions. Initially, general seed improvement plans included provisions for regional seminars or workshops yearly or biennially. These seminars were to provide a forum for discussions of mutual interest, and consideration of problems common to several countries along with the development of methods to solve outstanding problems. It was hoped that a regional approach could be taken on broad issues and that individual countries could take initiative in such areas as deemed advisable.

Following the seminars, seed improvement training schools (short courses) were to be conducted within the region. In these training courses, professional and technical personnel responsible in various capacities for seed improvement programs in their countries were to attend. Subject matter areas were to include foundation seed production, certified seed programs, seed testing and seed processing.

sent for training get full-time attention from all members of the staff. The time spent (which may vary from one day to three weeks) and services rendered would be hard to justify without the contract.

Research

International students studying for advanced degrees in Agronomy-Seed Technology are encouraged to select research areas related to particular problems existing in their own country. Examples of such studies include: correlation between specific gravity and vigor of rice seed; deterioration of rice seed in storage; dormancy in rice seed; maturation of grain sorghum seed; methods for predicting seed longevity; and many studies on various aspects of seed storage. In addition, four cooperative studies - with Taiwan, Thailand, Philippine Islands, and Costa Rica - on the influence of seed moisture content and packaging materials on transoceanic shipment and subsequent storage of seed have been completed. The results of the four studies have been made available to AID/W and various countries. Research has also been done on seed driers, seed storage chambers, and seed germinators. While some of these projects have not yet been completed, they have furnished much needed information on which to base recommendations to the various countries when such were requested.

ACCOMPLISHMENTS

It is probably not possible to accurately evaluate what has been accomplished as a result of the AID/MSU seed technology contract. It is known, however, that many developing countries place increasing emphasis on seed improvement as one of the most rapid, effective, and least expensive means of increasing food production. In concert with increasing emphasis on seed improvement there has been a great increase in the quantity and quality of seed testing laboratories, seed processing plants, seed storage facilities and foundation and certified seed programs.

Mississippi State University does not claim all the credit for these developments, but its staff in seed technology does know that the regional seed seminars, workshops, and training schools, consultation visits to individual countries, residence short courses, designs and plans developed, academic programs, personal correspondence and mass of technical information distributed have had a considerable effect.

The influence and effect of the contract is evident in many ways - in concrete items such as testing laboratories, processing plants, certification programs, and in the less tangible but highly important qualities of initiative and leadership. It has been a source of deep satisfaction to the staff of the Seed Technology Laboratory to see people they helped

A third step was to be a follow-up program in individual countries. A major part of the effort of initiating seed programs in each country would naturally rest with technicians in the country and the country USAID Mission. But more specific and technical help was to be provided - as needed - by experienced specialists in particular problem areas. The AID/MSU contract was developed to provide services in each of the three types of activity indicated above.

To a considerable extent these plans are being fulfilled and have been successful. Five seminars have been held in Latin America; three in the Far East; one each in the Near East and Africa. Three training courses have been conducted in Latin America and one in the Far East. Follow-up work has involved many different activities enumerated in the periodic reports. Travel to individual countries for specific work have been limited - not so much by the various countries' needs and desires for help - but by the fact that a country has to pay travel and per diem of the Mississippi State specialists.

These statements are made here because after eight years of working with AID by contract and ten years with the IADS/AID Seed Improvement Course, the MSU staff is convinced that the seminar-training school-follow-up approach is sound. This is not to say it is the only way to get a program across. We believe that at the present stage of development in Latin America and the Far East much individual attention on a country basis is needed. Countries in each of these regions have seed improvement programs in varying stages of development. These programs have been operating long enough so that many deficiencies and problems are clearly indicated. Individual country help would be an effective means of reducing deficiencies, solving the problems, and re-charting the program on a more progressive and effective path. The use of contract funds for travel to individual countries on request would expedite matters and accelerate the development of seed improvement programs.

The existence of the contract and services available under it should be more widely publicized. Recent contact with participants in a training course in Brazil from throughout Latin America revealed that there was a need for some of the services available under the contract, but that there was almost complete ignorance as to the existence or nature of the contract. This same situation pertains in other regions.

There is an urgent need for more training courses in seed improvement in the various regions. For example, there is much interest and need for a training course in and for Central America. The courses previously held in Chile and Brazil were effective but did not adequately consider the unique Central American problems and needs. Rather the courses were slanted toward the seed problems prevailing in the temperate and sub-tropical climates of the relatively developed countries of Chile,

Peru, Brazil and Argentina. Those problems peculiar to tropical climates and crops received only minor attention.

More follow-up work needs to be done. Seed processing plant designs and equipment specifications need to be translated into operating plants and programs. While the design and specifications can be done at MSU, some supervision needs to be exercised during erection and construction of the facility and installation of the equipment. Finally, the technicians in the country need to be trained in the effective and efficient operation of the facilities.

The Seed Technology Laboratory is well aware of its responsibilities and obligations under the contract. It welcomes even more opportunities to be of service to the various countries cooperating with AID.

March 1, 1967 - June 30, 1968

(Actual period covered, March 1, 1967 - June 30, 1968)

I. TECHNICAL ASSISTANCE

A. Morocco Project

In 1964 the Government of Morocco and USAID entered into a joint project to expand and accelerate a program for production, processing, and distribution of improved seed, mainly cereals. To accomplish the purposes of the project it was necessary to develop and construct seed drying, processing and storage facilities. It was further planned that the seed facilities would also serve as a training and demonstration center for seed improvement.

At the request of USAID/Morocco (TOAID A551, 1964) and under the provisions of contract MSU/AID-W-607, the Mississippi State University designed the physical plant needed for the program and developed specifications and recommendations for necessary equipment. Complete plans including recommendations, blueprints, specifications were submitted to USAID/Morocco in 1964.

The equipment for the facilities was ordered by USAID for the GOM pilot seed plant in 1964 and 1965 and the project was phased out in 1965. Due to a shortage of funds, however, the GOM did not undertake the construction of the buildings to house the facilities, until March, 1967. Just after the start of construction, USAID/Morocco requested the services of a seed processing plant engineer under subject contract.

Charles E. Vaughan, MSU seed processing specialist, was assigned to the project. He reviewed the plans already developed, made modifications as appropriate on basis of new information provided and left for Morocco on May 14, 1967.

Vaughan was in Morocco during the period May 14, 1967 to July 5, 1967. While in Morocco he accomplished the following tasks:

- (1) Equipment was uncrated, inspected and assembled.
- (2) Specifications for structural steel needed for the plant were developed and the steel was ordered.
- (3) Construction of the plant, which was progressing at a very slow pace, was accelerated and the foundation, structural supports and some walls were completed before Vaughan's departure. This was accomplished through consultation and coordination of activities by INRA (GOM's National Agronomic Research Institute) and the contractors.
- (4) A Campbell seed dryer previously ordered by INRA was inspected and uncrated. A suitable site for it was selected at Deroua and a concrete building was designed to house the dryer.
- (5) Recommendations and specifications for completion of the seed plant and drying facilities were developed and discussed with INRA and USAID officials.

Vaughan returned to MSU on July 5, 1967. His work and recommendations were reviewed by other MSU specialists and a report incorporating specifications and recommendations was filed with USAID/Morocco and AID/W.

Contact was maintained with INRA and USAID/Morocco and progress of construction was monitored. In January, 1968, we were alerted that the technical assistance of an engineer seed specialist would be needed in April - May. G. Burns Welch, MSU agricultural engineer-seed specialist was assigned to the project. During February, March and early April, 1968, he designed and drew up plans for accessories needed for installation of equipment, plotted the layout of equipment and flow sequences of the several kinds of seed to be handled by the plant.

At the request of USAID/Morocco and on approval from AID/W, Dr. Welch left for Morocco on April 18, 1968, and rendered technical assistance until his return on June 1, 1968. While in Morocco, he accomplished the following:

- (1) All cleaning equipment was positioned and installed in the seed plant.
- (2) Surge and hopper bottom bins were assembled, structural supports fabricated, and the bins positioned over the equipment.
- (3) Elevators and other conveying equipment were assembled and erected.
- (4) All equipment and conveyors were check tested for operational performance through use of a portable generator. This was necessary since the power line bringing electricity to the plant is not yet complete.
- (5) The corn seed dryer was check tested and training in its use and operation was given.
- (6) Preliminary plans for further expansion of the plant and dryer at a later date were developed in cooperation with INRA technicians.

Dr. Welch returned to home station on June 1. Immediately on his return he held extensive discussions with Hamid Benhalima, student participant from Morocco, on technical aspects of the seed harvesting, drying, processing, treating and storage operations to be performed by the plant. Mr. Benhalima had just completed all requirements for his B.S. degree in Agronomy - Seed Technology at MSU. After attending a communications conference for AID participants in the Midwest, he will return to Morocco as principal technician in the seed processing - drying section of the seed improvement program in Morocco.

We anticipate that additional technical assistance will be requested at the time the plant becomes fully operational and the first seed crop is ready for conditioning and processing. This assistance will emphasize training of operators in the effective and efficient operation and use of the facilities.

B. Honduras Project

Work initiated in 1964 on development of a complete improved seed program for Honduras was continued. The scope and details of the project were given in previous reports. Three trips were made to Honduras in connection with the project during the period covered by this report.

(1) April 17-May 3, 1967. G. M. Dougherty, MSU Seed Specialist, assisted the GOH in final check testing and initial operation of the San Pedro Sula corn and rice seed facility. On-the-job training was provided to Honduran technicians. A. H. Boyd, Jr., MSU Seed Specialist, accompanied Dougherty and assisted him in accomplishment of the work at no cost to AID.

(2) December 5 - 22, 1967. Dougherty returned to Honduras to advise and supervise installation of seed drying, processing, storage equipment for the Tegucigalpa bean and sorghum seed plant.

(3) February 2 - 16, 1968. Dougherty again traveled to Honduras to oversee initial operation of the Tegucigalpa seed plant during the bean processing season. He gave on-the-job training to Honduras technicians assigned to the plant.

In addition to these trips to Honduras, continual assistance has been provided to the GOH and USAID/Honduras on development of the over-all program. This was necessary because there are only 2 partially trained and knowledgeable seed specialists working in the program in Honduras. One of these Honduran specialists and another newly employed for the program are currently receiving additional training in seed work at MSU.

The Tegucigalpa plant was officially dedicated by the President of Honduras on March 14, 1968, with the diplomatic corps of other Central American countries as invited guests.

The Honduran seed program is in full operation and has already been so successful that original goals have had to be raised to meet the demand for improved seed.

Some idea of the scope and size of the facilities developed for Honduras can be gained from total investment in the two seed facilities:

<u>Seed Plants</u>	<u>Total Cost, Lempiras</u>
San Pedro Sula	500,000
Tegucigalpa	383,000
	<u>883,000</u>

Lempiras 2 = US \$1.00

The San Pedro Plant has been operational since early 1967 and has already processed over 13,000 cwt. of improved corn seed. The Tegucigalpa plant, in operation only a few months, has already processed 1200 cwt. of beans.

C. Peru Project

In early 1967 we were contracted by the contract coordinator of the North Carolina State/AID-Peru contract to explore the possibility of MSU providing technical assistance to the Ministry of Agriculture, Government of Peru, on renovation and remodeling of their seed drying, processing and storage facilities. After consultation with AID/W, it was agreed that James M. Beck stationed with the MSU/AID-Brazil contract in Rio would serve as consultant for a week to the N.C. State contract group in Peru to make an on-the-spot review of needs. This was accomplished in May 1967. After his return to Rio, Beck reported his observations and recommendations to MSU. These served as a basis for the development of designs and specifications for remodeling and renovation of the facilities. Three specialists were assigned to the task and complete recommendations, blue prints and specifications were transmitted to Peru in August 24, 1967.

Shortly after this time we received word from Peru that the GOP budget allocations to the project were insufficient for financing of the facility and as a consequence it was being postponed.

In March 1968 we were again contacted by Peru and advised that the Rockefeller Foundation had agreed to finance the purchase of the equipment for the seed facility. They requested that we provide technical specifications for certain equipment and redesign some components of the facility. This work was completed in early April 1968, and completed plans and specifications were transmitted to Peru and to the Rockefeller Foundation for review. Receipt of the material was acknowledged by RT and Peru, but no further information on status of the project has been received to this date.

D. El Salvador Project

In November, 1967, Don F. Grabe of the MSU staff visited briefly in El Salvador in connection with a project that MSU is coordinating in the Central America region for AID/W and AID/ROCAP. While in El Salvador he discussed a problem transmitted to us earlier by the Ministry of Agriculture, GOES. It developed that the GOES wanted to expand and remodel their seed improvement center and needed some technical assistance. Grabe gathered such data as he could on the problem and needs for later reference should a formal request for assistance under AID-W-607 materialize.

On March 1, we received a letter from AID/W (Bureau for Latin America) transmitting a copy of an Airgram from USAID/ES requesting that assistance be provided to the GOES toward improvement and remodeling of facilities at the seed improvement center. Since A. H. Boyd, Jr., of the MSU staff was scheduled to consult in El Salvador for one week in connection with the regional project referred to above, it was decided that the assistance could be most economically provided if it were simply added to the objectives of this already scheduled visit. Thus, the cost of a separate trip would be avoided.

Boyd visited in El Salvador March 18-25 and thoroughly reviewed the seed center's present and future needs with USAID/ES and GOES officials. He gathered essential data and made drawings and photographs of the present facilities on site.

Following Boyd's return to home station in April, 1968, the El Salvador project was reviewed and discussed by the staff. Appropriate specialists were assigned to develop plans, and prepare drawings and technical specifications for improvement and expansion of facilities at the seed center.

Completed recommendations, plans, drawings and specifications were transmitted to the GOES through USAID/ES on June 19, 1968.

It is anticipated that additional assistance will be required after the plans are reviewed and actual expansion of the facilities is initiated.

E. East Pakistan Project

In early 1968 we were contacted by AID/W (NESA) about technical assistance and consultation services needed for a project in East Pakistan. The project included a study to determine the feasibility of a capital loan for a seed improvement program in East Pakistan. In making the study, the needs for such a program, its impact on general agricultural development, repayment plan for the loan, and kind and scope of program needed would have to be determined.

H. D. Bunch, R. K. Matthes and Rupert Johnson (seed specialist, agricultural engineer and agricultural economist, respectively) were assigned to the project. They left for East Pakistan on May 6, 1968, and remained in East Pakistan until June 7, 1968. While in East Pakistan they reviewed all aspects of seed improvement as well as general agricultural development, and gathered essential data for the study through interviews, on-the-spot inspections, and conferences with USAID/East Pakistan and EP agencies involved.

A report of the study is in preparation and should be completed in about one month.

F. Miscellaneous Projects

The projects described above are the major ones involving technical assistance during the period covered in this report. In addition, considerable assistance has been and is being provided on a less informal basis to the following:

(1) India - designs for a model seed drying-processing plant for the GOT's very successful National Seeds Corporation are being reviewed and modified to better serve its purpose, namely, training of seed specialists and plant operators. While in India on assignment under another project (February 1968), detailed discussions were held with Indian Agricultural Research Institute officials on establishment of a Seed Technology Department in the Institute. This department would provide for a group of experienced professionals to assist and guide the rapidly developing Indian seed industry along constructive and technically sound lines. Assistance on both of these programs is continuing.

(2) Turkey - at the request of USAID/Turkey, we gave advice on the GOT's plan to transfer seed production and distribution from the public to the private sector over the next few years. It was most gratifying to us to learn that a government was voluntarily relinquishing control of a successful seed program to private interests.

II. TRAINING AND EDUCATIONAL RESOURCE DEVELOPMENT

A. Training

1. Short Courses

a. The 12th annual Seed Improvement Training Course for International Participants was held June 12-July 14, 1967. This course

is organized and coordinated by AID/W and IADS/USDA and carried out by MSU. Fourteen participants from the following countries participated in the course: India-4; Korea-1; Nigeria-4; Panama-3; Peru-1; Honduras-1.

b. The 13th annual Seed Improvement Training Course was scheduled for June 10-July 20, 1968. It is in session at the time of this report. Fourteen participants from the following countries are in attendance: India-6; Ghana-3; East Pakistan-3; Venezuela-1; Honduras-1.

2. Special Training

Specialized training was arranged and given as requested for individuals or small groups as follows.

March 1 - June 12, 1967	B. W. Singh, India Seed testing
May 3 - 4, 1967	B. Choudhury, India Vegetable seed
June 12 - 16, 1967	M. Gries-Honig, Israel Seed Technology (Dr. Gries-Honig was a participant in the first Seed Improvement Training Course at MSU in 1956).
July 17- 27, 1967	J. R. McCroy, Jr., Univ. of Tenn. - AID/India Contract team, Seed improvement, processing, storage and drying.
August 2 - 4, 1967	Twelve Brazilian Participants from Purdue Univ./AID-Brazil contract program. Agricultural development and seed improvement.
September 4-8, 1967	Messrs. Arancibia and Escudero, Chile, Rockefeller Foundation. Seed certification and foundation seed programs.

November 6-11, 1967	James A. Clifton, AID Advisor assigned to USAID/Afghanistan. Seed program development.
October 25-27, 1967	Seed Team, (6 members), India, Rockefeller Foundation. Seed program development.
April 4 - 5, 1967	Col. Osmado Mondonedo, Philippines Government, Administrator of GOP Rice and Corn programs. Seed improvement.
April 29-May 7, 1968	Brazilian Seed Regulatory Team (10 participants), NSU/AID Brazil contract. Seed regulatory activities.
May 30-June 5, 1968	Indian Seed Industry Development Team (7 participants). Organization of a commercial seed industry.
May 31 - June 5, 1968	Mr. C. Mao, Taiwan. Commercial seedsman. Seed production.

B. Training Materials

The first handbook of a projected series on the major aspects of seed technology was completed and printed; Handbook No. 1 "Seed Processing and Handling". January 1968, 295 pages, illustrated.

Three other handbooks are in various stages of preparation.

- (1) Seed Drying - first draft of manuscript completed.
- (2) Seed Storage - portion of manuscript completed.
- (3) Seed Plant Design - portion of manuscript completed.

In addition to these activities, various mimeographed training materials were prepared on specific subjects for use in training activities and for distribution on request.

III. RESEARCH AND DEVELOPMENT

Research and development activities have emphasized the problems of seed drying, storage and deterioration in the tropical environments characteristic of most of the less developed countries.

A. Seed Drying

A combination bin-bag drying system was designed and constructed for research on seed drying under conditions of high humidity and temperature. The drying unit will be operational by mid-summer.

Model drying system studies on the sorption-desorption characteristics of seed under tropical conditions were initiated in the fall of 1967. These studies are in progress. Tropical environments are provided in temperature-humidity conditioned rooms specially constructed for the research.

A simple inexpensive method for measuring the moisture content of seed during drying is under development. The method consists of sealing a small seed sample in a pint jar with an especially prepared lithium chloride impregnated paper strip. The paper strip changes from a pink to blue color in 1 to 2 hours if the seeds are sufficiently dry for storage. This method is now in the field testing stage.

B. Seed Storage

Major emphasis in the seed storage area has been given to establishing design criteria for conditioned seed storage facilities. This work involves determination of heat and moisture vapor transmission through various types of construction materials, and integration of cooling and dehumidification equipment into a balanced efficient system.

A study on use of plastic seed packaging materials to preserve seed vitality under very adverse tropical conditions has just been completed and the data are being compiled. The study involved storage of soybean, wheat and corn seed in an environment of 85° F. and 85% relative humidity. It was conducted in cooperation with the Owen-Illinois Research Center, Toledo, Ohio.

C. Seed Deterioration

The patterns of deterioration of rice, corn and peanut seed stored in controlled environments are under study to establish maximum levels of deterioration that can be tolerated without serious consequences to the performance characteristics of seed. This information will be important in establishing economical and practical design criteria for seed storage facilities.

IV. MISCELLANEOUS

As usual, a significant portion of services rendered involved answering voluminous correspondence with seed specialists from many countries. Many of these correspondants received part or all of their training in seed improvement at MSU, and rely on our group for advice on the various problems encountered in their work. Problems range from rather simple seed testing problems to very complex ones in the area of production, harvesting and processing.

Much of the correspondence involves requests for information on specific subjects, for example, seed certification. These requests are filled from our library of reprints, especially prepared information sheets, photocopies of articles, and other reference materials on seed technology.

Summary of Man Days Expended Per Project and Activity^{1/}

<u>Activity</u>	<u>Professional Services</u> Man Days Expended ^{2/}	
	<u>Overseas</u>	<u>Home Station</u>
I. Technical Assistance (Specific Projects)		
A. Morocco project	99 (49) ^{3/}	33
B. Honduras project	48 (16)	65
C. Peru project	0	42
D. El Salvador	8	37

^{1/} Because each overseas assignment and the resultant back-stopping required an individual report and the fact that the results of activities in research, development of educational materials, etc. were printed and distributed as they were prepared, the method of reporting "Services Rendered" was revised and reduced, each year starting with this report, upon instructions from AID/W.

^{2/} Calculations based on 8 hours per day; 260 man days per year.

^{3/} Numbers in parentheses indicate portion of time spent during FY'67.

48

E. East Pakistan	93	31
F. Miscellaneous (India)	<u>6</u>	<u>21</u>
Subtotal	254 (65)	229

II. Training and Educational Resources Development

A. Training		
1. Short Courses	0	90
2. Special Training	0	140
3. Advanced Training	0	100
B. Preparation of training aides and materials		<u>150</u>
Subtotal		480

III. Research and Development

A. Seed Drying	0	260
B. Seed Storage	0	240
C. Seed Deterioration	0	<u>280</u>
Subtotal		780

IV. Miscellaneous (problem solving and informational services rendered through correspondence)

Totals	254 (65)	<u>1,789</u>
--------	----------	--------------

Non-Professional Services

Type	Man Days Expended	
	<u>Overseas</u>	<u>Home Station</u>
A. Secretarial and Clerical	0	400
B. Sub-professional (maintenance, janitorial work, student laboratory assistants, etc.)		500
		<u>900</u>

July 1, 1968 - January 1, 1970

TECHNICAL ASSISTANCE

A. Morocco

Following assignments in Morocco in May-June, 1967, and April-June, 1968, assistance and advice has continued to be given on request. The processing facility near Rabat is in operation but still limited in activity and effectiveness by non-availability of electricity (portable generator is currently used).

B. East Pakistan

Information obtained and observations made by three-man team during feasibility study of Farm Improvement, Seed Processing and Drying and Storage Facilities for East Pakistan was analyzed and compiled in a report to AID on the economic and technical feasibility of the projects. The report was submitted to AID/W. Action has not yet been taken by GOP to implement study and recommendations. In late December, 1969, emergency assistance was requested by TA and NESA in developing techniques for breaking dormancy in 800 tons of rice seed. This problem is presently under consideration.

C. Indonesia

G. B. Welch was assigned to USAID/Indonesia during the period 5 August to 14 September, 1968, for consultation on rice seed drying and storage. He observed conditions and made appropriate recommendations to USAID/Indonesia based on his study. Two trainees from Indonesia attended the 1969 Seed Improvement Training Course at MSU to develop technical skills requisite for developing an on-going seed program.

D. Laos

While G. B. Welch was in Indonesia in September, 1968, a request was made by USAID/Laos for stop-over consultation visit before he returned to home station. Welch was in Laos for the period 15 September to 28 September, 1968, and held general discussions with USAID personnel and Laotian technicians on the facilities and personnel needed for a beginning seed program. Subsequently, two technicians from Laos participated in the 1969 Seed Improvement Training Course held at MSU in June-July, 1969. Additional information has been provided to Laos on minimum needs for initiating a seed program. It is anticipated that additional consulting assistance will be requested once the minimum facilities are developed.

E. El Salvador

Assistance to El Salvador was continued. A. H. Boyd and J. M. Beck conferred with GES seed specialists relative to progress of work on drying and processing facilities designed and recommended in June, 1968. Technical problems related to construction of conditioned storage warehouses were resolved in discussion with ES Ministry of Agriculture engineers. The design proposed for the processing plant was reviewed and it was re-emphasized that the low roof line on the existing building was a serious limitation. ES technicians agreed to consider the feasibility of a new design based on elevation of a section of roof of the building to an appropriate height.

In follow-up correspondence, the proposal to elevate a section of the roof was accepted and a revised design and layout of the facility was prepared. The revised design and specifications were submitted to GES through USAID/ES in June, 1969.

A brief consultation visit was made to El Salvador in November, 1969, in connection with other assignments in Central America. Beck and Boyd discussed progress of the facilities with ES Ministry specialists. The plans and recommendations developed for the facilities are progressing rapidly. ES plans to request additional assistance on seed facilities for another location.

F. Honduras

Assistance to Honduras on development of a seed program was continued. Boyd spent several days on a problem-solving consultation assignment in Honduras in October, 1968. He also discussed plans for expanding one of the two existing facilities. Dougherty was on consultation assignment in Honduras during the period May 12-18, 1969. The objective of his visit was to establish exact needs in terms of equipment for expansion of existing facilities. On the basis of discussions held and information obtained, complete plans for revising the San Pedro facility to increase capacity and develop capability for rice seed drying and processing was submitted to GOH in August, 1969.

Boyd and Beck consulted briefly with GOH specialists on the plans for remodeling of the San Pedro facility in late October, 1969. The plans were explained in detail, slight revisions made and accepted by GOH. While in Honduras, they also assisted in the resolution of some equipment maintenance problems. The chief specialist of the GOH seed program completed degree training in Seed Technology at MSU in January, 1969, and is presently doing an outstanding job.

G. Colombia

At the request of USAID/Colombia, G. M. Dougherty went on consultation assignment with the Caja Agraria in Colombia for the period October 21 - November 18, 1968. He obtained data and information on the extensive seed operations conducted by the Caja Agraria. On his return this information and data were analyzed, the major weaknesses in the program identified and plans for their resolution were elaborated. Specifications and designs for three facilities were developed and submitted to Caja. One facility is already under construction.

Since inadequate training appeared to be one of the main weaknesses in the Colombia seed program, a training course was organized and conducted in October, 1969, by C. H. Andrews and G. M. Dougherty. Twenty-eight Colombian seed specialists from both the public and private sectors participated in the three week course. The course emphasized practical work. Delouche visited for 5 days in Colombia near the end of the course and participated in another review of seed problems in Colombia. Basically, considerable funds have been expended on facilities that are simply not effective or adequate for seed. Thus, three of the rather large facilities have to be extensively modified to make them work, and plans for several completely new facilities have to be developed.

C. H. Andrews and GERAL SHARP (consultant) visited in Colombia for consultation on tropical grass seed production and processing problems in January-February, 1969. The problems are very difficult and not amenable to completely satisfactory resolution. However, the best recommendations based on experiences with the difficult range grasses in the U.S. were given.

Based on the magnitude of the seed program in Colombia, existing investments and the multitude of problems associated with the existing facilities (which were improperly designed) considerable assistance will be required over the next several years.

H. Panama

Assistance to Panama on seed program development was continued. G. M. Dougherty consulted with GOP seed specialists during the period March 23-April 13, 1969. Panama's seed improvement program was re-evaluated and additional improvements recommended. The objective

is to double the output of seeds in the next three years to serve the needs of 10,000 small farmers recently included in a stepped-up agricultural development program.

The necessary plans were developed, specifications elaborated and a report submitted covering the plans and recommendations.

A "Stop-over" visit in Panama was made by Dougherty, in November, 1969. The status of the plans for the improvements were discussed. On return to home station technical specifications for equipment needed, and cost estimates were prepared and submitted to USAID/Panama and GOP. It is anticipated that additional assistance will be required by Panama in "installation" of the improvements and modifications recommended.

I. Ecuador

At request of USAID/Ecuador, G. M. Dougherty went for consultation during period April 28 - May 11, 1969. The present status of seed program development in Ecuador was reviewed and plans for subsequent development considered. Tentative equipment and facilities needs were outlined. Also, tentative plans for a training course for workers in the Ecuadoran seed program were made.

Sr. Orellano, Head of the Seed Program in Ecuador visited at MSU in July, 1969. (A key technician also attended the Seed Improvement Training Course at MSU in June- July, 1969). Additional plans for the training course were made and the date set for November 10-December 3, 1969. Further discussions were also held on the equipment and facility needs. Designs and plans prepared by GOE engineers were critically reviewed and modified as necessary.

A three and a half week seed technology training course was conducted in Ecuador from November 10-December 3, 1969. Delouche and Vaughan were assigned as instructors. Twenty-six participants attended the course - all from Ecuador. The course was sponsored by USAID/Ecuador, the Rockefeller Foundation Project in Ecuador, and INIAP, GOE. It was most successful.

Over-all the Ecuadoran seed program is making rapid progress. Currently, assistance is being provided on layout design of seed drying processing and storage facilities.

Ecuador intends to request timely periodic assistance under AID-W-607 over the next several years.

J. Peru

Assistance to Peru on development of corn drying and processing facilities was continued. G. B. Welch went for consulting assignment to Peru for the period September 8 - October 4, 1969. All of the equipment originally recommended for the facilities were on hand. However, the building had not been started due to shortage of funds. Welch developed plans and designs for all necessary accessory and handling equipment needed for the facility, contacted local fabricators and discussed with them the items that were needed. The sites for both the processing and drying facility were also laid out.

K. Philippines

At the request of USAID/Philippines in late summer of 1969, preliminary planning was begun on a model seed processing-drying-storage facility for rice and corn seed. An equipment list was reviewed, modifications made, and tentative plans drawn for a foundation seed facility to be located at the Maligaya Experiment Station in Luzon. This project is currently in progress. USAID/Philippines already has a request on file with AID/W for a consultant to assist in the installation and shake-down operation of equipment when the facilities are completed. It is anticipated that this consultation assignment will be made in the Spring of 1970.

L. Miscellaneous

Substantial assistance was also given (by correspondence) to USAID/Bolivia, USAID/India, Stanford Research Institute (Ethiopia project), AID contractors and Colombo Plan workers in Thailand, Ford Foundation contractors in Malaysia, private seed companies in Kenya, India, Brazil and Central America, and the Rockefeller Foundation/India and Ecuador during the period of this report. This assistance was primarily concerned with specific seed problems for which appropriate recommendations were made as possible.

II. TRAINING AND EDUCATIONAL RESOURCE DEVELOPMENT

1. Short Courses

a. In addition to training courses conducted in Colombia and Ecuador in Fall, 1969, the I and II Seed Technology Training Courses for Central America were conducted at the Escuela Agricola Panamericana,

Zamorano, Honduras, in cooperation with USAID/ROCAP and the Escuela. The first course was held in September-October, 1968 with participants from all C. A. countries. The second course was held in November, 1969, with participants from all C. A. countries except El Salvador. Several participants from Panama also participated. The courses for C.A. were conducted under a separate but closely related contract with AID/ROCAP. Indeed, the limited funds under the contract only covered travel supplies and the contract could not have been entered into except for MSU's commitment to seed program development in the LDC's and adequate support under W-607.

b. The 13th Annual Seed Improvement Training Course was held June 10 - July 20, 1968. Fourteen participants from the following countries were in attendance: India - 6; Ghana - 3; East Pakistan - 3; Venezuela - 1; Honduras - 1.

c. The 14th Annual Seed Improvement Training Course was held June 8-July 12, 1968. In terms of number of participants and interest the 14th course was the biggest and best yet. Twenty-five participants from the following countries were in attendance during the 5 week course; India - 10; Indonesia - 5; Laos - 2; Ghana - 3; Ecuador - 1; Afghanistan -3; and Nepal - 1.

2. Special Training

Specialized training was arranged and given as requested for many individual visitors during the period including AID personnel on home leave.

3. Training Materials

Handbook No. 1 "Seed Processing and Handling" published in January, 1968, had to be reprinted in January, 1969. It is currently being translated into Spanish by AID/RTAC, Mexico City. 2000 copies of the Spanish edition are on order from the Latin American Missions. Mississippi Agri. Expt. Station Technical Bulletin 51 "The Tetrazolium Test for Seed Viability" is also being translated into Spanish by RTAC. A reprinting of the French translation was necessary during the period of this report.

Handbook No. 2, "Seed Drying" is in manuscript. Illustrations are being prepared and plans are to submit it to AID for review in late February, 1970, and publish in March, 1970. We anticipate that it will be even more successful than Handbook No. 1.

A third Handbook of the series (Handbook No. 3) is in detailed outline form. It will deal comprehensively with the important subject of seed storage. This topic will be considered from the physiological, agronomic, and engineering aspects.

Various other reference materials on seed storage, seed testing, seed processing, seed certification and seed program development were prepared, printed in mimeographed form and made available to international students, visitor, and correspondents in many countries around the world.

Several other publications covering important components of the seed program or very specialized operations are in the planning stage; "Seed Multiplication and Certification," "Maize Seed Harvesting, Drying, Processing and Storage," and "Rice Seed Drying, Processing and Storage."

III. RESEARCH AND DEVELOPMENT

Because the exceptionally heavy demands for technical assistance and training activities during the period of this report, research activities had to be somewhat curtailed. However, research and development work has continued in the areas of drying and storage of seed under tropical conditions. Information and data derived from this continually fed into our design and planning activities. Much of the information developed in the seed drying work has been integrated with other available information into the Handbook on Seed Drying.

Additional research is in progress to resolve some of the problems associated with drying of temperature-sensitive vegetable seed.

STATISTICAL SUMMARY

July 1, 1968 - March 31, 1969

Summary of Man Days Expended
Per Specific Activity or Project

Professional Services

<u>Activity/Project</u>	<u>Man Days</u>	
	<u>Overseas</u>	<u>Home Station</u>
I. Technical Assistance (Missions)		
A. East Pakistan (feasibility study)	0	81

<u>Activity/Project</u>	<u>Man Days</u>	
	<u>Overseas</u>	<u>Home Station</u>
B. Morocco (follow-up)		11
C. Indonesia (rice seed)	41	13
D. Laos (rice seed)	14	18
E. El Salvador (seed plant)	6	33
F. Honduras (seed plant)	7	15
G. Colombia (seed plant and grass seed)	53	61
H. Panama (seed improvement)	8	6
I. Miscellaneous		
SKI		6
India		17
Bolivia		8
Thailand		13
Subtotal	<u>124</u>	<u>282</u>
II. Training		250
III. Preparation of Educational Materials		300
IV. Research and Development		470
V. Miscellaneous (Administration, problem solving, logistics)		250
Subtotal		<u>1676</u>

Non-Professional Services

	<u>Home Station</u>
A. Clerical and Secretarial	380
B. Technicians and Aides	<u>425</u>
Subtotal	805
Totals	2763
	124

STATISTICAL SUMMARY

April 1, 1969 - March 31, 1970

Summary of Man Days Expended
Per Project and ActivityProfessional Services

<u>Activity</u>	Man Days Expended	
	<u>Overseas</u>	<u>Home Station</u>
I. Technical Assistance (Missions)		
A. Bolivia (general consultation)	5	4
B. Brazil (seed drying)		7
C. Colombia (training course, seed plants)	65	56
D. Congo (seed program)	35	
E. Dominican Republic (seed certification)		5
F. Ecuador (training course, seed plant)	72	62
G. El Salvador (seed plant)	4	34
H. Ghana (general)		4

<u>Activity</u>	Man Days Expended	
	<u>Overseas</u>	<u>Home Station</u>
I. Guatemala (general)		24
J. Honduras (seed plant)	16	30
K. India (general)		27
L. Indonesia (general)		6
M. Laos (seed facilities)		37
N. Nicaragua (general)		3
O. Nigeria (seed dryer)		5
P. E. Pakistan (dormancy)		14
W. Pakistan (storage)		11
Q. Panama (seed improvement)	18	23
R. Peru (seed plant)	33	22
S. Philippines (seed plant)		31
T. Uruguay (general)		3
U. Vietnam (seed drying)		15
. Subtotal	248	403

	Man Days Expended	
	<u>Overseas</u>	<u>Home Station</u>
II. Training and Educational Resources Development		
A. Training		170
B. Preparation of training aides and materials		<u>210</u>
Subtotal		380
III. Research and Development		
A. Seed Drying		170
B. Seed Storage		200
C. Seed Deterioration		170
D. Seed Facility Design		90
E. Quality Control		<u>70</u>
Subtotal		700
IV. Miscellaneous		
A. Administration (includes routine correspondence)	110	
B. Problem Solving and informational services rendered through correspondence		<u> </u>
Subtotal	<u> </u>	<u>210</u>
Totals	248	1693
<u>Non-Professional Services</u>		
A. Secretarial and Clerical		450
B. Technicians, Aides and Assistants		<u>720</u>
Total		1170

STATISTICAL SUMMARY

April 1, 1970 - March 31, 1971

Summary of Man Days Expended
Per Project and ActivityProfessional Services

<u>Activity</u>	Man Days Expended	
	<u>Overseas</u>	<u>Home Station</u>
I. Technical Assistance (Countries & Missions)		
A. Afghanistan (Consultations with USAID/ Afghanistan seed advisor and counterpart.)		14
B. Brazil (Consultations and discussions with visitors.)		12
C. Chad (Consultation with visiting advisor from Chad.)		3
D. Chile (Consultations with visitor from Chile's seed program.)		10
E. Colombia (Follow-up work related to previous assignments.)		18
F. Congo (Follow-up work related to assignment in Feb.-March, 1970.)		62
G. Costa Rica* (Visits in Oct. 1970, 10 days, Dec. 1970 and March, 1971, 6 days, follow-up work with visitor from Costa Rica who will head certain segments of seed program.)	21	51

<u>Activity</u>	Man Days Expended	
	<u>Overseas</u>	<u>Home Station</u>
H. Ecuador* (Follow-up work on previous assignment.)		11
I. Guatemala (General consultations on seed matters; assistance on design of seed corn facility for private company.)		8
J. Guayana (Conferences with visitor from Ministry of Agriculture on rice seed program.)		11
K. Honduras (Assignment in July, 1970, and follow-up work.)	15	23
L. India (Assignment and follow-up work, and conferences with visitors from India seed program and industry.)	90	88
M. Laos (Follow-up work to visit from USAID/Laos advisor in February, 1970)		13
N. Malaysia (Consultation via correspondence on seed drying and storage.)		7
O. Nicaragua* (Consultation with officials from private seed company in Nicaragua, stop-over visit to Nicaragua in connection with assignments with USAID/ Costa Rica, and follow-up work on design of seed facilities.)	2	43

<u>Activity</u>	Man Days Expended	
	<u>Overseas</u>	<u>Home Station</u>
P. Niger (Conferences with USAID/Nigeria advisor on seed drying and storage and follow-up work.)		11
Q. Panama* (Consultation and development of specifications for equipment.)	18	28
R. Peru (Assignment to complete installation of seed plant and follow-up work.)	16	33
S. Philippines* One specialist worked on the development of the overall seed program and one on the installation of equipment at the Seed Processing plant at Maligaya. Request for additional backstopping work received prior to return of technicians to home station.	110	63
T. ROCAP* (Stop-over visit in connection with assignment to USAID/ Honduras, and follow-up work on seed program problems and plans in Central America region. Development of materials for ROCAP regional training course.		6
U. Venezuela (Conference with visitors from Ministry of Agriculture)		7
V. Viet Nam (Consultations <u>via</u> correspondence on seed drying and packaging.)		7

<u>Activity</u>	Man Days Expended	
	<u>Overseas</u>	<u>Home Station</u>
W. Indonesia* (Development of Seed Legislation)	27	20
Subtotal	<u>300</u>	<u>549</u>
* Project active and continuing under Basic Ordering Agreement AID/csd 2976.		
II. Training and Education Resource Development		
A. Training (non-academic participants at home station)		132
B. Preparation of informational materials, references, and training aides		234
Subtotal		<u>366</u>
III. Adaptive Research and Development		
A. Seed Drying		110
B. Seed Storage		140
C. Seed Deterioration		165
D. Quality Control		55
E. Seed Program Development		85
F. Seed Facility Design		<u>110</u>
Subtotal		665
IV. Administration		
(Includes management of contract activities, routine correspondence related to seed program development and problems in the LDC's that were not covered in I above, and activities connected with review of contract.)		196
Subtotal		<u>196</u>

Non-Professional Services

		<u>Home Static</u>
A.	Secretarial and Clerical	570
B.	Technicians and Technical Aides	<u>755</u>
	subtotal	1325
Totals	300	3101

Appendix I

University Staff Contributing to AID-W-607 Contract

Current Staff

ADMINISTRATION

Dr. W. L. Giles, President of Mississippi State University
Dr. Louis N. Wise, Vice President for Agriculture and Forestry
Dr. J. H. Anderson, Director, Agricultural Experiment Station
Dr. C. E. Lindley, Dean of the College of Agriculture
Mr. Robert T. Clapp, Dean of the School of Forestry
Mr. William M. Bost, Director, Agricultural Extension Service
Dr. C. Dale Hoover, Head, Department of Agronomy
Dr. William Fox, Head, Department of Agricultural Engineering
Dr. Clyde Singletary, Head, Department of Horticulture
Mr. Garnett Thomas, Chief Accountant, Agricultural Experiment Station

SEED TECHNOLOGY LABORATORY

Dr. James C. Delouche, Agronomist, In Charge
Dr. C. Hunter Andrews, Associate Agronomist, Research, Teaching
Mr. James M. Beck, Engineering Technician
Mr. A. H. Boyd, Jr., Assistant Agronomist, Foundation Seed, Research
Mr. George M. Dougherty, Associate Agronomist, Research, Teaching
Dr. Kenneth Matthes, Associate Agricultural Engineer, Research
Dr. Howard C. Potts, Associate Agronomist, Research, Teaching
Mr. Charles Sciple, Assistant Agronomist, State Seed Laboratory, Teaching
Dr. Charles E. Vaughan, Associate Agronomist, Research, Teaching
Mrs. Carol Kirschenbaum, Secretary
Mrs. Barbara Sigman, Secretary
Mrs. Sue Garrett, Secretary
Mrs. Irene Caldwell, Laboratory Technician
Mrs. Sue Reed, Laboratory Technician
Mr. Curtis Reed, Field Technician
Mr. Dero Kinard, Field Technician, Foundation Seed

Extension Service

Dr. Charles Baskin, Associate Extension Agronomist, Seed & Grain Specialis

OFFICE OF INTERNATIONAL PROGRAMS IN AGRICULTURE & FORESTRY

Dr. H. D. Bunch, Director
Miss Sandi Tarleton, Secretary

MSU/AID Ia 165 - Brazil Contract

Mr. Dumont A. Souleyrette, Chief of Party
Dr. G. Burns Welch, Agricultural Engineer

MSU/AID NESA 379 - India Contract

Dr. Bill R. Gergg, Chief of Party
Mr. Alvin Law, Seed Marketing Specialist
Mr. Paul Young, Seed Production and Certification Specialist

MSU/AID Ia-408 - Guatemala

Dr. Al Plant, Chief of Party

FORMER STAFF MEMBERS, AID-W-607

Harold Byrd
William P. Caldwell
Don Grabe
James Helmer
T. Wayne Still

Appendix II

OVERSEAS ASSIGNMENTS

April, 1958 - March, 1971

<u>Year</u>	<u>Country</u>	<u>Man Days</u> ^{1/}	<u>Consultant</u>	<u>Type of Assignment</u> ^{2/}
1958	Paraguay	60	Wise	P
1958	Chile	7	Wise	P
1959	Chile	52	Bunch, Andrews	TR
1959	Argentina	14	Bunch, Andrews	TA
1959	Peru	24	Bunch, Andrews	S
1959	Japan (regional)	19	Wise	S
1959	Taiwan	92	Grabe	TR
1959	Taiwan	97	Andrews	TR
1960	Chile	60	Delouche, Vaughan & Andrews	TR
1960	Costa Rica	14	Vaughan, Welch	TA
1960	Africa (regional)	30	Wise	P
1960	Taiwan (regional)	54	Delouche, Andrews	TR
1960	Taiwan	40	Delouche, Andrews	TA
1960	Costa Rica	15	Vaughan	TA
1960	Columbia (regional)	21	Bunch	TR
1961	Philippines (regional)	60	Bunch	TR
1961	Kenya (regional)	42	Bunch	TR
1961	Ghana	7	Bunch	TA
1963	Costa Rica	21	Bunch	TA
1963	Brazil (regional)	21	Bunch	TR
1963	Taiwan	60	Vaughan	TA
1963	Vietnam	30	Dougherty	P
1963	Taiwan	30	Dougherty	TA
1964	Brazil	18	Delouche	TA
1964	Brazil (regional)	14	Delouche	TR
1964	Venezuela	12	Beck	TA
1965	Brazil	88	Beck	TA
1965	Honduras	14	Delouche	P
1966	Panama	20	Welch, Gregg	TA
1966	Panama	21	Welch	TA
1966	ROCAP (regional)	20	Welch, Gregg	TA

1/

Includes only actual days out of country. Time spent on preparation of materials before and after these assignments generally was twice that of the overseas time.

<u>Year</u>	<u>Country</u>	<u>Man Days</u>	<u>Consultant</u>	<u>Type of Assignment</u>
1967	Panama	40	Gregg	TA
1967	Morocco	80	Vaughan	TA
1967	Morocco	42	Welch	TA
1967	Honduras	30	Dougherty, Boyd	TA
1967	Honduras	21	Dougherty	TA
1967	Peru	7	Beck	TA
1968	Honduras	7	Dougherty	TR
1968	El Salvador	6	Boyd	TA
1968	East Pakistan	90	Bunch, Matthes, Johnson	P
1968	Indonesia	41	Welch	TA
1968	Laos	14	Welch	TA
1968	Colombia	28	Dougherty	TA
1969	Honduras	16	Dougherty	TA
1969	Colombia	61	Andrews, Dougherty Delouche	TR
1969	Colombia	53	Andrews, Sharp	TA
1969	Panama	18	Dougherty	TA
1969	Ecuador	14	Dougherty	TA
1969	Ecuador	48	Delouche, Vaughan	TR
1969	Peru	33	Welch	TA
1970	Congo	35	Delouche	P
1970	Costa Rica	16	Beck	TA
1970	Honduras	15	Boyd	TA
1970	India	90	Dougherty	TA
1970	Nicaragua	2	Beck	TA
1970	Peru	16	Matthes	TA
1971	Philippines	110	Beck, Vaughan	TA & P
1971	Costa Rica	5	Boyd	TA
1971	Panama	18	Dougherty	TA
1971	Indonesia	27	Delouche	TA
		<u>2053</u>		

2/P. - planning assistance to USAID missions or assistance in technical planning or comprehensive seed programs in specific countries

T.R. - formal training courses covering various specialized areas of seed technology

T.A. - specific technical assistance to a particular AID Mission supported project or country program

S. - AID's consultant to a seed seminar

Appendix III

Chronological Listing of Technical Reports,
Training Materials and Special Papers

1. Staff, Suggested Plans for Proposed Seed Processing Plant in Paraguay. Mississippi State University, State College, Miss., January, 1959. 11 p. Mimeo, 4 blueprints. (Out of print).
2. Staff, Curso Especial de Capacitacion Sobre Manejo Seleccion y Analisis de Semillas Para America Latina, 16 de Febrero-13 Marzo, 1959. 48 p. Mimeo. Illustrated. (Out of print).
3. Staff, Germination. Mississippi State University, State College, Miss., February, 1959. 18 p. Mimeo. Illustrated. (Out of print).
4. Staff, El Analisis de Pureza y la Identificacion de las Semillas. Mississippi State University, State College, Mississippi, February, 1959. 31 p. Illustrated. Translated into Spanish by Sra. Sylvia de Fuentes. (Out of print).
5. Staff, Services Rendered under the Agreement between the International Cooperation Administration and Mississippi State University, ICA-W-607. Mississippi State University, State College, Miss., March, 1959. 4 p., Mimeo. (Out of print).
6. H. D. Bunch and C. H. Andrews, Report of First Latin America Seed Training Course to International Cooperation Administration, Chillan Chile, February 16 - March 13, 1959. Mississippi State University, State College, Miss., March, 1959. 13 p., Mimeo. (Out or print).
7. Louis N. Wise, Recommendations Made to ICA/Washington (on 2nd Far East Seed Improvement Workshop, May 11 - 29, Tokyo, Japan). Mississippi State University, State College, Miss., June, 1959. 4 p. Mimeo. (Out of print).
8. Don F. Grabe, Seed Certification in Taiwan - Evaluation and Recommendations. Mississippi State University, State College, Miss., September 18, 1959. 26 p., Mimeo. (Out of print).
9. Don F. Grabe, A Seed Testing Laboratory for the Far East Countries. Mississippi State University, State College, Miss., October 26, 1959. 6 p. Mimeo. 1 blueprint.
10. C. H. Andrews, Seed Certification Program in Taiwan - Subsequent Evaluations and Recommendations. Mississippi State University, State College, Miss., November 25, 1959. 16 p., Mimeo. (Out of print).

11. J. C. Delouche, Evaluacion de los Analisis de Germinacion. Miss. State University, State College, Miss., December, 1959. 33 p. illustrated. Spanish translation by Mrs. June Adams.
12. Staff, Prospecto Cursos Especiales Para America Latina en Analisis de Semillas y Seleccion de Semillas. Mississippi State University, State College, Miss., January, 1960. 11 p. (Out of print).
13. Staff, Services Rendered under the Agreement between the International Cooperation Administration and Mississippi State University, ICA-W-607. Mississippi State University, State College, Miss., March, 1960. Mimeo. (Out of print).
14. James C. Delouche, C. H. Andrews, and C. E. Vaughan, Report to ICA on the Second Latin American Seed Processing and Seed Testing Short Course, Santiago/Chillan, Chile, February 8-27, 1960. Mississippi State University, State College, Miss., March, 1960. 39 p. (Out of print).
15. Staff, Seed Technology Laboratory (compiled and edited by), Seed Treatment. Mississippi State University, State College, Miss., June, 1960. 72 p.
16. C. H. Andrews and C. E. Vaughan, Report to ICA on Consultative Visits to South and Central America, February 29 - March 11, 1960. Mississippi State University, State College, Miss., March, 1960. 8 p., Mimeo. (Out of print).
17. Staff, Seed Technology Laboratory (compiled and edited by), Foundation Seed. Mississippi State University, State College, Miss., June, 1960. 64 p. (Out of print).
18. Staff, Seed Technology Laboratory (compiled and edited by), Seed Certification. Mississippi State University, State College, Miss., June, 1960. 74 p. (Out of print).
19. Staff, Prospectus - Far East Seed Technology Training Course, August 29 - September 24, 1960. Mississippi State University, State College, Miss., June, 1960. 6 p. (Out of print).
20. Staff, Seed Technology Laboratory (compiled and edited by), Articles Closely Related to Seed Improvement. Mississippi State University, State College, Miss., June, 1960. 77p. (Out of print).
21. Staff, Seed Technology Laboratory (compiled and edited by), Seed Drying and Storage. Mississippi State University, State College, Miss., June, 1960. 85 p. (Out of print).

22. C. E. Vaughan, Report to ICA and USOM/Costa Rica (on consultative visit). Mississippi State University, State College, Miss., Sept., 1960. 9 p., 7 blueprints. (Out of print).
23. J. C. Delouche and C. H. Andrews, Report to ICA on the Far East Seed Technology Training Course, August 29 - September 24, 1960. Mississippi State University, State College, Miss., October, 1960. 27 p. (Out of print).
24. W. P. Caldwell and H. Dean Bunch, Effect of Seed Moisture and Packaging Container upon Viability and Vigor of Wheat, Cabbage and Soybean Seeds during Transoceanic Shipment and Subsequent Storage. 1961 Annual Meeting, American Society of Agronomy, Agronomy Abstracts (1961) p. 72. (Also mimeographed version of original paper, Mississippi State University, State College, Miss., November, 1961. 4 p. illustrated).
25. Staff, Services Rendered under the Agreement between the International Cooperation and Mississippi State University, PIO/T 99-13-065-3-89026, March 18, 1958 - March 17, 1961. Mississippi State University, State College, Miss. March, 1961. 9 p. Mimeo. (Out of print).
26. T. Y. Sung and James C. Delouche, Relation of Specific Gravity to Vigor and Viability in Rice Seed. Proceedings Association Official Seed Analysts Vol. 52, p. 162-168. 1962.
27. C. E. Vaughan, G. B. Welch and H. D. Bunch. Seed Processing Machinery. Mississippi State University, State College, Miss., June, 1962. 59 p. (Out of print).
28. H. D. Bunch, Seed Teams, Help---Build a Better World. Crops and Soils, June - July Issue, 1962. (Out of print).
29. Staff, Services Rendered under the Agreement between the Agency for International Development and Mississippi State University, AID-W-607. Mississippi State University, State College, Miss., October, 1962. 17 p. Mimeo. (Out of print).
30. J. C. Delouche, T. W. Still, Mabel Raspet, and Myrta Lienhard; L'Essai au Tetrazolium pour Determiner la Vitalite' des Semences., Centre Regional D'Editions Techniques (C.R.E.T.). Collection: Techniques Americaines - 61. Paris, 1966, 90 pp. (French edition of Mississippi Agricultural Experiment Station Technical Bull. 51, November, 1962, 63 p. illustrated).

31. Staff, Services Rendered under the Agreement between the Agency for International Development and Mississippi State University, AID-W-607, March 18, 1959 - December 19, 1963. Mississippi State University, State College, Miss., January, 1963. 21 pp. Mimeo. (Out of print).
32. Louis N. Wise, Report on Seed Improvement Consultation Visit to Brazil April 7-20, 1963. Mississippi State University, State College, Miss., May 8, 1963. 9 p. Mimeo. (Out of print).
33. Staff, Specifications - Seed Drying and Processing Plant, Republic of Ghana. Mississippi State University, State College, Miss., July, 1963. 50 p., 7 blueprints.
34. C. E. Vaughan, Prospectus - Short Course on Seed Processing - September 2-8, 1963, Provincial Department of Agriculture and Forestry, Taichung, Taiwan. Mississippi State University, State College, Miss., August, 1963. 14 p. In English and Chinese. (Out of print).
35. C. E. Vaughan, Seed Processing in Taiwan - Evaluation and Recommendations. Mississippi State University, State College, Miss., September 18, 1963. 10 p., Mimeo. (Out of print).
36. G. M. Dougherty, Report (to AID) on Seed Improvement Consultation in Republic of South Vietnam, August 8 - September 3, 1963. Mississippi State University, State College, Miss., September 3, 1963. 8 p. Mimeo. (Out of print).
37. H. D. Bunch, Report of a Trip to Brazil with a Stopover in Costa Rica as Consultant in Seed Technology, June 3 - August 16, 1963. Mississippi State University, State College, Miss., September, 1963. 4 p. Mimeo. (Out of print).
38. Staff, Specifications for Foundation Seed Processing Plant, Agronomy Department, Vicosa, Minas Gerais, Brazil. Mississippi State University, State College, Miss., October, 1963. 10 p. 2 blueprints.
39. W. P. Caldwell and H. D. Bunch, Transoceanic Shipment and Subsequent Storage of Nine Kinds of Seed Packaged in Different Containers at Various Moisture Levels. Mississippi State University, State College, Miss., October, 1963. 28 p. (Out of print).
40. G. M. Dougherty, Report on Seed Technology Consultation in Taiwan Dept. 16 - Oct. 15, 1963. Mississippi State University, State College, Miss., Oct. 15, 1963. 7 p. Mimeo. (Out of print).

41. H. D. Bunch, J. Sutherland, Jr. and Clair R. Porter. Report on Consultation Mission (Seed Improvement) to Brazil. Mississippi State Univ. State College, Miss., October, 1963. 16 p. Mimeo. (Out of print).
42. Staff, Specifications (for) Seed Storage, Drying, and Processing Plant, Rio Grande do Sul Brazil. Mississippi State University, State College, Miss., November, 1963. 100 p. Mimeo. 5 blueprints.
43. J. C. Delouche and Nghe Thi Nguyen, Methods for Overcoming Seed Dormancy in Rice. Proceedings Association Official Seed Analysts, Vol. 54, p. 41-49. 1964.
44. Shu-Hui Feng, "Seed Dormancy in Johnsongrass, Argentine Bahiagrass and Pensacola Bahiagrass". Master of Science Thesis, Miss. State University, State College, Miss. 1964.
45. Pil Ju Kim, "Effect of Different Levels of Relative Humidity on Hygroscopic Moisture Equilibrium Content and Viability of Forage Legume and Grass Seed". Master of Science Thesis, Mississippi State University, State College, Miss. 1964.
46. Ismu Sukanto Sumelo, "Maturation of Sorghum Seed in Mississippi". Master of Science Thesis, Miss. State University, State College, Miss. 1964.
47. Staff, Specifications for Grain Elevator and Bagged Storage Warehouse Consejo Nacional de Produccion, Barranca, Costa Rica. Mississippi State Univ., State College, Miss., June, 1964. 109 p. 7 blueprints.
48. Staff, Specifications for Seed Processing Plant for National Institute of Agronomic Research, Rabat, Morocco. Miss. State University, State College, Miss., July, 1964. 6 p. 3 blueprints.
49. J. D. Helmer and J. C. Delouche, Rice Seed Storage in Costa Rica as Influenced by Seed Moisture Content and Packaging Containers. Miss. State Univ., State College, Miss., August, 1964. 28 p.
50. Staff, Seed Processing Plant (for Centro de Investigaciones Agronomicas, Maracay, Venezuela). Miss. State Univ., State College, Miss. November, 1964. 10 p. Mimeo. 3 blueprints.
51. Staff, Services Rendered under the Agreement between the Agency for International Development and Miss. State University, AID-W-607, March 18, 1958 - December 31, 1964. Mississippi State Univ., State College, Miss., December, 1964. 26 p. Mimeo. (Out of print).

52. Staff, Services Rendered under the Agreement between the Agency for International Development and Mississippi State University, AID-W-607, March 18, 1958 - December 31, 1965. Mississippi State University, State College, Miss., December, 1965. 31 p. Mimeo. (Out of print).
53. Edwardo Zink. Immediate and Latent Effects of Mechanical Abuse on the Germination of Soybean Seed. Miss. State University, State College, Miss. 1966. Master of Science Thesis.
54. J. D. Helmer, Formulacion y Desarrollo de un Programa de Certificacion de Semillas. (Invitational paper presented to annual meeting of Proyecto Cooperativa Centroamericano para el Mejoramiento de Cultivos Alimenticos, March 28 - April 1, 1966, Managua, Nicaragua). Mississippi State University, State College, Miss., March, 1966. 12 p. Mimeo. (Out of print).
55. G. B. Welch and B. R. Gregg., Conclusions and Recommendations as Part of Summary Report to USAID/Panama on Panama Accelerated Seed Program, April 4 - 14, 1966. Mississippi State University, State College, Miss., May, 1966. 7 p. Mimeo.
56. G. Burns Welch and B. R. Gregg, Report to USAID/Panama on Panama Accelerated Seed Program (consultation visit, April 4 - 14, 1966). Mississippi State University, State College, Miss., June, 1966. 29 p. Mimeo.
57. J. C. Delouche, A World to Feed. Seedsmen's Digest, Seed Processor's Clinic, Vol. 17, September, 1966. p. 34.
58. B. R. Gregg, Informal Report on Visits with Central American AID/Missions, August 15 - September 5, 1966. Mississippi State University, State College, Miss., October, 1966. 38 p. Mimeo.
59. Staff, Honduran Seed Program - Considerations, Designs, and Specifications for Seed Drying - Processing - Storage - Office Facilities. Mississippi State University, State College, Miss., January, 1967. 85 p. 17 blueprints. (Compilation and summary of 11 separate reports, including blueprints, issued during period October, 1964 - December, 1966).
60. A. J. M. Azizul Islam. Comparison of Methods for Evaluating Deterioration in Rice Seed. Mississippi State University, State College, Miss., January, 1967. Master of Science Thesis. 61 p.

61. Staff, Services Rendered under AID-W-607 by Mississippi State University, January 1, 1966 - March 1, 1967. Mississippi State University, State College, Miss., March, 1967. 5 p. Mimeo. (Out of print).
62. B. R. Gregg, Report to USAID/Panama on Technical Assistance to the Pure Seed Program of the Republic of Panama, February 13 - March 17, 1967. Mississippi State University, State College, Miss., April, 1967. 29 p. Mimeo.
63. Prasoot Sittisrourng, Storage of Rice (Oryza sativa) and Cowpea (Vigna sinensis) Seed. Mississippi State University, State College, Miss., June, 1967. Master of Science Thesis. 59 p.
64. G. B. Welch, and James C. Delouche, Seed Processing and Storage Facilities for Tropical Areas. Mississippi State University, State College, Mississippi, June 1967. Paper No. 67-318, Presented at 60th Annual Meeting, American Society of Agricultural Engineers, Saskatoon, Canada. 20 p. Mimeo.
65. Staff, Report to the Agency for International Development, Services Rendered under the Agreement between the Agency for International Development and Mississippi State University, AID-W-607, March 18, 1958, March 17, 1967. Mississippi State University, State College, Miss., June, 1967. 58 p. Illustrated.
66. H. C. Potts and G. T. Peden, Jr., Progress Report, July 1, 1966 - June 30, 1967. Mississippi State University, State College, Miss., June, 1967. 21 p. Mimeo.
67. C. E. Vaughan, Report to USAID/Morocco on Services Rendered (Consultation Assignment). Mississippi State University, State College, Miss., July, 1967. 8 p. Mimeo.
68. Staff, Report 1 - Design Characteristics of La Molina (Peru) Seed Processing Plant. Report 2 - Ear Corn Dryer Loading and Unloading Conveyor System for La Molina. Mississippi State University, State College, Miss., August, 1967. Report No. 1, 10 p. Report No. 2, 9p., 4 blueprints.
69. J. C. Delouche, Spotlight on Seeds. Seedsmen's Digest, Seed Processors Clinic, Vol. 18, August, 1967. p. 27.
70. Anastacio Tolentino Mercado. Moisture Equilibrium and Quality Evaluation of Five Kinds of Seed Stored at Various Relative Humidities. Mississippi State University, State College, Miss., August, 1967. Master of Science Thesis, 56 p.

71. C. E. Vaughan, B. R. Gregg, and James C. Delouche. ed., Seed Processing and Handling. Mississippi State University, State College, Miss., January, 1968. Handbook No. 1.295 p. Illustrated.
72. G. Burns Welch and J. C. Delouche, Environmental and Structural Requirements for Seed Storage. Mississippi State University, State College, Miss., January, 1968. Journal Paper No. 1607, Miss. Agr. Exp. Station, presented at 1968 Annual Meeting, Southeast Region, American Society of Agricultural Engineers. 14 p. Mimeo.
73. Staff, Report 2 (Revision) Ear Corn Dryer Loading and Unloading Conveyor System for La Molina (Peru). Mississippi State University, State College, Miss., Date of revision March, 1968. 9 p. Mimeo. 2 blueprints.
74. Staff, Report 1 (Revised) - Design Characteristics and Equipment Specification List for La Molina (Peru) Seed Processing Plant. Mississippi State University, State College, Miss., Date of revision, March, 1968. 9 p. Mimeo. 2 blueprints.
75. J. C. Delouche, Agricultural Development. Seedsmen's Digest. Seed Processors Clinic, Vol. 19, May, 1968. p. 32.
76. Staff, Requirements, Considerations, Specifications and Equipment Price List for the San Andres Experiment Station Seed Facilities, San Andres, El Salvador. Mississippi State University, State College, Miss., June, 1968. 50 p., 10 blueprints.
77. A. H. Boyd, Jr., Report on Services Rendered under AID-W-607 to El Salvador during Period 18 March - 25 March, 1968. Mississippi State University, State College, Miss., June, 1968. 3 p. Mimeo.
78. C. C. Baskin, T. T. Rushing, and J. C. Delouche, Influence of Packaging Materials on Storage of Wheat, Corn and Soybean Seed under Temperate, Artic and Tropical Conditions. Mississippi State University, State College, Miss., June, 1968. 20 p. Mimeo.
79. Staff, Services Rendered Under the Agreement between the Agency for International Development and Mississippi State University, AID-W-607 (Supplement to Report for Period March 18, 1958 - March 17, 1967). Mississippi State University, State College, Miss., June, 1968. 18 p. Mimeo.
80. G. B. Welch and J. C. Delouche, Low Cost Temperature Controlled Rooms. Mississippi State Univ., State College, Miss., August, 1968. Miscellaneous Publication 1. 13 p. Illustrated.

81. G. B. Welch, Report on Consultation Assignment with USAID/Morocco, April 18 - June 1, 1968. Mississippi State University, State College, Miss., August, 1968. 7 p. Mimeo.
82. G. B. Welch. Report to AID/W on Consultation Assignment with USAID/Laos. Oct. 1968. 8 p. Mimeo.
83. A. H. Boyd and J. M. Beck. Report to AID/W on Consultation Assignment with USAID/El Salvador. Oct. 1968. 5 p. Mimeo.
84. A. H. Boyd. Report to AID on Brief Consultation Visit with USAID/Honduras. Oct. 1968. 7 p. Mimeo.
85. G. B. Welch. Report to AID/W on Consultation Assignment with USAID/Indonesia; Rice Seed Drying and Processing. Oct. 1968. 9 p. Mimeo.
86. G. M. Dougherty. Report to AID/Colombia on Consultation Visit with Caja Agraria. Nov. 1968. 18 pp. Mimeo.
87. Staff. Considerations, Recommendations and Specifications for Basic Seed Corn Facilities, at Cerete, Palmira and Pubenza, Colombia. December, 1968. 54 pp. Mimeo. 10 blueprints.
88. H. D. Bunch, R. B. Johnson and R. K. Matthes. Report to AID: Farm Improvement, Seed Processing; Drying and Storage Facilities for East Pakistan, Feb. 1969. Printed. 71 pages. Illustrated.
89. G. W. Sharp and C. H. Andrews. Report to AID/Colombia on Consultation Visit with Caja Agraria on Grass Seed Harvesting-Processing Problems. Feb. 1969. 25 pp. Mimeo.
90. R. K. Matthes, J. C. Delouche and G. B. Welch. Seed Conditioning for Tropical Environments. Presented at SE Section, ASAE, Mobile. February, 1969. 23 pp. Illustrated.
91. G. M. Dougherty. Report to AID/Panama on Consultation Visit with Panama's Seed Improvement Program. April, 1969. 31 pp. Mimeo.
92. G. M. Dougherty. Report to Ministerio Agricultura, Comercio, Industrialas on Panama Seed Improvement Program. April, 1969. 12 pp. Mimeo.
93. G. M. Dougherty. Report to AID/Honduras in Consultation Visit with Honduran Seed Improvement Program. June, 1969. 9 p. Mimeo.

94. G. M. Dougherty. Report to AID/Ecuador on Consultation Visit with the Ecuador Seed Certification Department. June 1969. 13 pp. Mimeo.
95. Staff. Revised Requirements, Considerations, Specifications and Equipment Price List for the San Andres Experiment Station Seed Facilities, San Andres, El Salvador. June, 1969. 47 pp. 5 blueprints.
96. Staff. Revised Seed Processing and Rice Drying Facility for Honduras Seed Program, San Pedro Sula. August, 1969. 19 pp. Mimeo. 5 blueprints.
97. Staff. Specifications for Seed Testing and Sampling Equipment for the Guayaquil and Quito Seed Testing Laboratories. September, 1969. 9 pp. Mimeo.
98. G. B. Welch. Report on Consultation Assignment with USAID/Peru. 8 pp. 3 blueprints. Oct. 1969.
99. G. M. Dougherty. Report to USAID/Colombia and Caja Agraria on Recommendations for Modifications to Cerete and Valledupar Seed Facilities. 26 pp. 5 drawings. Nov. 1969.
100. R. K. Matthes, G. B. Welch, J. C. Delouche and G. M. Dougherty. Drying, Processing and Storage of Corn Seed in Tropical and Subtropical Environments. ASAE Paper No. 69-577. ASAE Meeting, Chicago. Dec. 1969. 27 pp. Illustrated.
101. K. S. Chien, R. K. Matthes, and B. P. Verma. Dimensional Analysis of Seed Moisture Movement in Deep-Bed Drying. ASAE Paper No. 69-833. ASAE Meeting Chicago. Dec. 1969. 24 pp.
102. Staff. Equipment Specifications for the Chiriqui, Divisa and Panama City Seed Facilities (Panama). December, 1969. 15 pp. Mimeo.
103. A. H. Boyd and J. M. Beck. Report to USAID/El Salvador on ES Seed Improvement Program. December, 1969. 4 p. Mimeo.
104. G. M. Dougherty. Report on Project Review Visits to Colombia, Peru, Bolivia, Ecuador, Panama, and Honduras. December, 1969. 17 p. Mimeo.
105. C. H. Andrews and G. M. Dougherty. Report to AID/W and USAID/Colombia on the First Colombian Seed Technology Training Course. December, 1969. 17pp. Mimeo.

106. Nelson Carvalho, Some Physiological Responses of Cowpea Seed (*Vigna sinensis*) to Mechanical Injury. Miss. State University State College, Miss. 1969. Master of Science Thesis.
107. Sylvia S. Chang. Physiological Study of Differences in Quality and Longevity among Seed of Two Inbred Lines of Corn and the Hybrid. Miss. State University, State College, Mississippi. 1969. Master of Science Thesis.
108. Nirmal S. Gill. Deterioration of Corn (*Zea mays* L.) Seed During Storage. Miss. State University, State College, Miss. 1969. Doctor of Philosophy Dissertation.
109. J. M. Beck. Preliminary Reports to USAID/Philippines on Design and Specifications of Seed Plant At Maligaya. 1970.
110. C. E. Vaughan, B. R. Gregg and J. C. Delouche, ed. Procesamiento Mecanico y Beneficio de Semillas. (Translation of Handbook No. 1, "Seed Processing and Handling," MSU, 1968.) Herrero Hermanos, Sucesores, S. A., Mexico. February, 1970. 284 pp. Illustrated.
111. G. M. Dougherty. Report to USAID/Colombia on Recommendations for Caja Agraria Seed Drying Facilities in Cerete and Valledupar. February, 1970. 7 pp. 1 drawing.
112. G. M. Dougherty. Considerations and Equipment Specifications for Ecuador Seed Certification Department. Feb. 1970. 13 pp. 3 drawings.
113. J. M. Beck and A. H. Boyd. Report to USAID/W on Review of Plans for Heat Pump Type Seed Dryer in Nigeria. 5 pp. 1 drawing. March, 1970.
114. J. C. Delouche. Breeder and Foundation Seed Programs. 21 pp. May, 1970.
115. J. C. Delouche. Changing Seed Program Needs in the LDC's. 21 pp. May, 1970.
116. Staff. Seed Technology Handbook. (Training References). 62 pp. June, 1970.
117. J. C. Delouche. Report to AID/W and USAID/Congo on Seed Program Development in Democratic Republic of the Congo. 125 pp. 5 drawings. June, 1970.
118. A. H. Boyd. Report to USAID/El Salvador on Consulting Visit to El Salvador Seed Improvement Program, 16 July-18 July, 1970. 6 pp.

119. A. H. Boyd. Report to USAID/Honduras on Consultation Visit with Honduran Seed Improvement Program, 1 July - 15 July, 1970. 26 pp. August, 1970.
120. J. C. Delouche and C. E. Vaughan, ed. Memoria de Cursos Sobre Tecnología de Semillas Realizados en America Latina. 569 pp. Illustrated, August, 1970.
121. J. C. Delouche. Report to USAID/ Costa Rican Seed Project. October, 1970. 28 pp. 1 drawing.
122. A. H. Boyd and J. M. Beck. Report to AID/Honduras on Consultation Visit with Honduran Seed Program. December, 1970. 6 p. Mimeo.
123. Bettaiya Rajanna. Some Trends in Seed Maturation of Rice (Oryza sativa L.). Miss. State University, State College, Miss. 1970 Master of Science Thesis.
124. Prasoot Sittisrourng. Deterioration of Rice (Oryza sativa) Seed in Storage and its Influence on Field Performance. Mississippi State University, State College, Miss. 1970. Doctor of Philosophy Dissertation.
125. Luiz A. B. de Castro. Some Factors Influencing the Yield and Quality of Carrot (Daucus carota L.) Seed. Mississippi State University, State College, Miss. 1970 Master of Science Thesis.
126. Augusto Aponte. Quality of Sesame Seed (Sesamum indicum L.) as Influenced by Storage Condition and Artificial Aging. Mississippi State University. State College, Miss. 1970. Master of Science Thesis.
127. Chia Chi Chen. Influence of Physiological Quality of Seed on Emergence, Growth and Yield of Some Vegetable Crops. Mississippi State University, State College, Miss. 1970. Master of Science Thesis.
128. Carlos Vechi. Physiological Responses of Cowpea (Vigna sinensis (L.) Savi) Seeds to Differential Deterioration Levels. Mississippi State University, State College, Miss. 1970. Master of Science Thesis.
129. J. C. Delouche. Seeds: Improving Programs Around the World. War on Hunger, Vol. 5, No. 3. p. 9-12. March, 1971.
130. G. M. Dougherty. Report to AID/W, USAID/India and TARAI Development Corporation on Tarai Project Seed Facilities. 46 pp. 7 drawings. January, 1971.

131. A. H. Boyd and G. M. Dougherty. Report to USAID/Nicaragua on Consulting Assignment to Rappaccioli-McGregor, S. A. 24 pp. 5 drawings. January, 1971.
132. J. C. Delouche. Seed Legislation Consultation in the Republic of Indonesia. April, 1971. 53 pp. Mimeo.
133. G. M. Dougherty. Seed Project Consultation in the Republic of Panama. April, 1971. 51 pp. Mimeo.
134. A. H. Boyd. Requirements and Equipment Specifications for Consejo Nacional de Produccion Barranca, Costa Rica, C. A. pp. 35. 10 drawings. April, 1971.
135. Kuang S. Chien, B. P. Verna and R. K. Matthes. Dimensional Analyses of Seed Moisture Movement in Deep Bed. In Press, Transactions of American Soc. Agricultural Engineers. May 1971.
136. C. E. Vaughan and J. M. Beck. Report to AID/W and USAID/Philippines on Seed Program Development in the Republic of the Philippines. May, 1971. 88 pp. Mimeo.

APPENDIX IV

A. List of international students who have enrolled in Mississippi State University as special (non-degree) students or as candidates for degrees in Agronomy-Seed Technology.

<u>Name</u>	<u>Country</u>	<u>Degree</u>	<u>Year</u>
Ampol Senanarong	Thailand	M. Agr.	1959
Joel A. Mascarenhas	Brazil	M.S.	1961
Sermasak Awakul	Thailand	M. Agr.	1962
Socdarmo Hodisoemarto	Indonesia	M. Agr.	1962
Martief Jemain	Indonesia	M. Agr.	1962
Gerritt Kasenda	Indonesia	M. Agr.	1962
Pricha Khambononda	Thailand	M. Agr.	1962
Noel Mamicpic	Philippines	M.S.	1962
Ponchai Pookamana	Thailand	M. Agr.	1962
Agoes Selim	Indonesia	Non-degree	1962
Tsay Yen Sung	China	M. Agr.	1962
Imam Mohamed Goma	Egypt	Non-degree	1963
Sanit Kittikorn	Thailand	M. Agr.	1963
Sung Man Lim	Korea	M.S.	1963
Fereidoon Niknam-Asi	Iran	Non-degree	1963
Sadjad Sjamsoe'oed	Indonesia	M. Agr.	1963
M. Samir M. Abdel-Al	Egypt	M.S.	1964
Shu-Hui Feng (Miss)	China	M.S.	1964
Huon C. Huor	Cambodia	B.S.	1964
Pil Ju Kim Joo (Mrs.)	Korea	M.S.	1964
Nghe Thi Nguyen (Miss)	Vietnam	M.S.	1964
Ismu Sukanto Suwelo	Indonesia	M.S.	1964
Jose Carlos Maschietto	Brazil	Non-degree	1965
Francisco Toledo	Brazil	Non-degree	1965
Mohmoud Farag Zaki	Egypt	Non-degree	1965
Parviz Maleki	Iran	M.S.	1966
Somchai Thamnoonragsa	Thailand	M. Agr.	1966
Eduardo Zink	Brazil	M.S.	1966
Azizul Islam	Pakistan	M.S.	1967
Erlinda Pili (Miss)	Philippines	M.S.	1967
Prasoot Sittisroung	Thailand	M.S.	1967
Carlos V. Herrera	Peru	M.S.	1969
Nelson De Carvalho	Brazil	M.S.	1969
Sylvia Shoo-hwa Chang	Taiwan	M.S.	1969
Nirmal Singh Gill	India	Ph.D.	1969

Appendix IV-A continued

<u>Name</u>	<u>Country</u>	<u>Degree</u>	<u>Year</u>
Jurnalis Kamil	Indonesia	non-degree	1969
Ratnakar Bhatkal	India	non-degree	1969
Quazi M. Ashraf	India	non-degree	1969
Narottam Toke	India	non-degree	1969
Bettaiya Rajanna	India	M.S.	1970
Luiz A. B. de Castro	Brazil	M.S.	1970
Augusto Aponte	Venezuela	M.S.	1970
Chia Chi Chen	Taiwan	M.S.	1970
Carlos Vechi	Brazil	M.S.	1970
Prasoot Sittisoung	Thailand	Ph.D.	1970
Mohammad Zaher	Afghanistan	non-degree	1970
Ramesh C. Bharali	India	non-degree	1970
Kirpal S. Gill	India	non-degree	1970
K. Jagannathan	India	non-degree	1970
L. K. S. Kachchhap	India	non-degree	1970
V. L. N. Sastry	India	non-degree	1970
R. C. Srivastava	India	non-degree	1970
Nuruz Zaman	E. Pakistan	non-degree	1970
I. M. Pacurar	Romania	non-degree	1970
T. S. Eugenio	Philippines	non-degree	1970
C. H. Domingo	Philippines	non-degree	1970
Bangalore Phaneendranath	India	M.S.	1971
Cilas Camargo	Brazil	M.S.	1971
Sergio Fagundes	Brazil	M.S.	1971
Lingegowda Hanumaiah	India	M.S.	1971
Maria Regina Sartori (Miss)	Brazil	M.S.	1971
Rozane Coelho (Mrs.)	Brazil	M.S.	1971
Fernando Gomez	Colombia	M.S.	1971

B. List of participants who have attended the five week "Special Course in Seed Improvement" at the Seed Technology Laboratory.

<u>Name</u>	<u>Country</u>	<u>Year</u>
Jose de Andrade	Brazil	1956
Kuang-chi Su	China	1956
Hernan Orellano	Ecuador	1956
C. E. Heliodromites	Greece	1956
Luis M. Castillo	Guatemala	1956
T.V. Reddy	India	1956
Markus Gries	Israel	1956
Armando Bogado	Paraguay	1956
Jorge Almenara	Peru	1956
E. C. Carandang	Philippines	1956
T. T. Gonzales	Philippines	1956
Eduardo Prieto	Spain	1956
Sala Dasananda	Thailand	1956
Prasit Yingkayun	Thailand	1956
Jose R. Goncalves	Brazil	1957
Oscar Caceres Jorquera	Chile	1957
Luis Del Villar Zarco	Chile	1957
Eleodoro Fuentes Parada	Chile	1957
Sergio Letelier Rosa	Chile	1957
Nicolas Campos Perez	Chile	1957
Gonzalo Velasquez Munoz	Chile	1957
Lian-fu Chen	China	1957
Rene Felipe Suarez	Cuba	1957
Ricardo Dominguez Valladares	El Salvador	1957
Oscar Nery Sosa	Guatemala	1957
Noubar Kasparian	Lebanon	1957
Luis Carlos Arosemena	Panama	1957
Somnart Dhammanuvong	Thailand	1957
Suvit Pushpavesa	Thailand	1957
Katarina Borojevic (Mrs.)	Yugoslavia	1957
Milanka Jankovic (Miss)	Yugoslavia	1957
Josip K. Ljubicic	Yugoslavia	1957
Todor Misic	Yugoslavia	1957
Olivera Pavlovic (Miss)	Yugoslavia	1957
Joze Spanning	Yugoslavia	1957
Jose Rodriguez	Mexico	1957
Juan Salazar	Mexico	1957
Mohamed C. Mustapha	Ceylon	1958
Alberto Vargas	Costa Rica	1958
Edel Olivera	Cuba	1958
Astolfo Fumagalli	Guatemala	1958

<u>Name</u>	<u>Country</u>	<u>Year</u>
Augusto C. Utrera	Guatemala	1958
R. Hadiwijoto	Indonesia	1958
S. Ronosoehardjo	Indonesia	1958
Sjamsoe'oed	Indonesia	1958
Soemantri	Indonesia	1958
Suhama	Indonesia	1958
Sumargono	Indonesia	1958
Jeune Haeng Ree	Korea	1958
Shaikh Mahboob	Pakistan	1958
Ampol Senanarong	Thailand	1958
Ahmet Azgezer	Turkey	1958
K. T. Boun Than	Cambodia	1959
A. S. Ranatunga	Ceylon	1959
Fernando Arancibia	Chile	1959
Yin Tieh Hsieh	China	1959
Nazar Dhesi	India	1959
A. Na Lampang	Thailand	1959
Kasem Sukhaband	Thailand	1959
Sanan Intratat	Thailand	1959
Prasert Suwanasuk	Thailand	1959
Antun Levakovic	Yugoslavia	1959
Ilija Zeng	Yugoslavia	1959
Francisco F. de Toledo	Brazil	1960
Flavio F. Rocha	Brazil	1960
Renato Ruschel	Brazil	1960
Yu-Wei Cheng	China	1960
Shih Ming Shaw	China	1960
Khalil K. S. Kheir	Jordan	1960
Sermsak Awakul	Thailand	1960
Pricha Khambanonda	Thailand	1960
Tong Phuoc Khue	Vietnam	1960
Jorge A. Del Aguila	Argentina	1961
Huon C. Huor	Cambodia	1961
Carlos Palma	Chile	1961
Martief Jemain	Indonesia	1961
Agoes Salim	Indonesia	1961
Uzeyir Solak	Turkey	1961
Kamal M. Hakim	Sudan	1961
O. Liberal (Mrs.)	Brazil	1962
T. Y. Sung	China	1962
H. A. Lardizabal	Honduras	1962
K. Prodjodarsono	Indonesia	1962
H. Soedarmo	Indonesia	1962
G. Kasenda	Indonesia	1962
K. Devahastin	Thailand	1962

<u>Name</u>	<u>Country</u>	<u>Year</u>
D. Sinthavalaya	Thailand	1962
P. Suvanajata	Thailand	1962
S. Cinki (Miss)	Turkey	1962
N. Spiaggi	Bolivia	1962
Juan E. Zenteno	Bolivia	1963
Keat Keng Sin	Cambodia	1963
Wen-chow Lee	China	1963
German A. Conteras	Costa Rica	1963
Otoniel E. Viera	Honduras	1963
Mannem D. Reddy	India	1963
S. Sadjad	Indonesia	1963
Abdul G. Bhatti	Pakistan	1963
Shah M. Hussain	Pakistan	1963
Suthep Thongmang	Thailand	1963
Luu Van Trung	Vietnam	1963
Jose C. Maschietto	Brazil	1964
Lien-teng Wu	China	1964
Halthore V. R. Iengar	India	1964
Ramananda Pattanayak	India	1964
Supojo Rahardjo	Indonesia	1964
S. Tjokrodihardjo	Indonesia	1964
Ismu S. Suwelo	Indonesia	1964
M'Hamel Mouline	Morocco	1964
Moussa Lahdya	Morocco	1964
Mohamed El Honsali	Morocco	1964
Hassan El Bostani	Morocco	1964
Mohammed K. Bazyar	Afganistan	1965
Bina Datta (Miss)	India	1965
Karam Singh Sandu	India	1965
K. C. Karyal	India	1965
Abdul H. A. Al-Younis	Iraq	1965
Ali Cherrat	Morocco	1965
Ahmed Moulay	Morocco	1965
Avdelkader Bentakfa	Morocco	1965
Hassan Abouzaid	Morocco	1965
Abdelaziz Lalaoui	Morocco	1965
Abdelfetrah Safraoui	Morocco	1965
Mohammed Mouloua	Morocco	1965
Azizul Islam	Pakistan	1965
Bonnert. Klyprayong	Thailand	1965
Thomas Adjei	Ghana	1966
Andrew Kwasi D. Yabani	Ghana	1966
Ezekiel Christian O. Lamptey	Ghana	1966
John Richard Ackah	Ghana	1966

<u>Name</u>	<u>Country</u>	<u>Year</u>
Kofi John Peprah	Ghana	1966
Roland Imoru Yakubu	Ghana	1966
Albert Llewelyn Agard	Guyana	1966
Abbass Moradi	Iran	1966
Phoumavong Phouangphan	Laos	1966
Prasoot Sittisroung	Thailand	1966
Hamid Benhalima	Morocco	1966
P. D. Singh	India	1967
B. N. Singh	India	1967
N. S. Gill	India	1967
M. M. Jain	India	1967
Y. S. Hamm	Korea	1967
S. Salau	Nigeria	1967
C. C. Anojulu	Nigeria	1967
Mrs. C. C. Anojulu	Nigeria	1967
D. O. Eboh	Nigeria	1967
S. A. Olusuyi	Nigeria	1967
C. M. Vejarano	Panama	1967
L. O. Lopez	Panama	1967
O. A. Tapia	Panama	1967
Carlos Herrera	Peru	1967
O. H. Flores	Honduras	1967
Vitthaldas F. Majmudar	India	1968
Himatlal R. Shah	India	1968
Sahkara I. Sitaraman	India	1968
Nihar R. Panigrahi	India	1968
Srinivasa M. Rao	India	1968
Mohammad A. Hakim	Pakistan	1968
Mohammad J. H. Khan	Pakistan	1968
Syed Mohammad A. Islam	Pakistan	1968
Timothy Yao Fie	Ghana	1968
M. A. Mahama	Ghana	1968
Joseph Wobil	Ghana	1968
Augusto Aponte	Venezuela	1968
Roberto Garcia A.	Honduras	1968
Sadikin Somaatmadja	Indonesia	1969
Vong Souvannaradj	Laos	1969
Jurnalís Kamil	Indonesia	1969
Udai Bhan Pandey	India	1969
Korsi Sebahang	Indonesia	1969
Gauri R. Shrestha	Nepal	1969
Oroth Choulamountry	Laos	1969
Humphrey Awuku Dudroha	Ghana	1969
Sayad Qurysh	Afghanistan	1969
P. C. Gupta	India	1969
Abala Kanta Sarma	India	1969
Abdul Hafiz Ferhadi	Afghanistan	1969

<u>Name</u>	<u>Country</u>	<u>Year</u>
Ebenazar Hesse-Owusu	Ghana	1969
Mohammad Siyah	Afghanistan	1969
Ramdas Dautik Patil	India	1969
Jaime Flores	Ecuador	1969
Jagbir Singh	India	1969
Ratnakar Bhatkal	India	1969
Quazi Mohamad Ashraf	India	1969
Emmanuel Mark Gyampoh	Ghana	1969
Chia Chi Chen	Taiwan	1969
Subhas Priya Bhattacharyya	India	1969
Narottam D. Toke	India	1969
Sutjiptadi Sutarman	Indonesia	1969
Lingegowda Hanumaiah	India	1969
Abdurrahman R. Daud	Indonesia	1969
Mohammad Zaher	Afghanistan	1970
Henry A. Akanko	Ghana	1970
Thoma Andoh	Ghana	1970
Lawrence K. Quainoo	Ghana	1970
Ramesh C. Bharali	India	1970
Kirpal S. Gill	India	1970
K. Jagannathan	India	1970
L. K. S. Kachchhap	India	1970
Shyam Rekhi	India	1970
V. L. N. Sastry	India	1970
R. C. Srivastava	India	1970
K. N. Urkuday	India	1970
Abdul H. Modjo	Indonesia	1970
B. S. Marip	Indonesia	1970
C. M. Sidik	Indonesia	1970
D. Z. S. Mawuntu	Indonesia	1970
A. A. H. Mansoor	Pakistan	1970
Nuruz Zaman	Pakistan	1970
I. M. Pacurar	Romania	1970
P. Vorask	Thailand	1970
T. S. Eugenio	Philippines	1970
C. N. Domingo	Philippines	1970

APPENDIX V

Xerox Copy

of the

Report
of the
Special Task Force
Established to
Review and Evaluate

The Mississippi State University Seed Project--AID/W-607
"Seed Processing and Testing"

Changing Seed Program Needs of the LDC's
Appraisal of Present Programs and Projection of Future Needs

Office of Agriculture and Fisheries
Bureau for Technical Assistance
Agency for International Development

June, 1970

Table of Contents

Summary. 1

A. Background and Purpose of Review 1

B. Project Activities Reviewed. 1

C. The Contract and Scope of Work 2

D. Accomplishments to Date. 2

E. Overall Assessment 3

F. Changing Seed Program Needs of the LDC's 4

G. New Contract Instrument Needed 6

H. Task Force Contract Recommendations. 7

I. Task Force Recommendations for Action by TA/AGF. 8

Attachment A -- Methodology of Review

Attachment B -- Current Campus-Based Activities under the MSU
Contract

Summary

Changing seed program needs of the LDC's brought about by the use of high-yielding varieties, represent a new dimension to the seed program. Policy planning, economic and social factors, financial-managerial-technical manpower requirements and institution development and organizational arrangements are required to meet these changing needs.

The Mississippi State University contract "Seed Processing and Testing" has gone through 12 years of successful implementation with the University performing exceptionally well in carrying out technical assistance in LDC's, in training and in research and development activities. The contract has provided technical assistance to the LDC's in seed improvement, including but not limited to seed technology, multiplication, processing, certification, storage and utilization.

To reflect current and future needs we believe that the relationship between AID and MSU should be redefined. A new contract, with a fresh scope of work, should be written. It can be financed through a continuation of the present system; through a "cost reimbursement Basic Ordering Agreement" or through a "Joint Section 211(d) grant and Basic Ordering Agreement arrangement".

The Task Force has made two classes of recommendations: those aimed at improving the performance of the contract and those requiring action on the part of TA/ACP--actions which recommend evaluations, studies and keeping the missions informed. (See part E of this report and part I for details of recommendations).

A. Background and Purpose of Review

The purposes of this review and evaluation were to:

1. Assess present seed improvement programs and the LDC's changing seed program needs, particularly as they relate to implications of the "Green Revolution".
2. Develop a rationale for establishing Task Order financing methods and funding requirements for future programs.
3. Develop a seed and crop improvement project proposal that is responsive to the LDC's changing needs, based upon the review panel's findings.

B. Project Activities Reviewed

1. Research and technical services available to and being utilized by AID/W and USAID's world-wide.

2. Technical, engineering and program advisory services rendered by contractor "on-campus", as they pertain to USAID/host country projects/activities.
3. Training projects conducted in the U.S. and abroad, both nationally and regionally.
4. Publications completed and under preparation, including their utilization and distribution.

C. The Contract and Scope of Work

The Mississippi State University technical support contract was executed on March 18, 1957, in the amount of \$18,000. The contract has been renewed for the past 12 years - steadily increasing in amount to the current annual funding of \$145,000. The scope of work has been expanded since the contract was originally signed - principally by an amendment in 1967. It currently calls for assistance leading toward the establishment or expansion of seed industries in the developing countries:

1. Organization of seed improvement programs, including the identification and analysis of production, processing and storage needs.
2. Surveys and advice on planning, design and construction of physical facilities.
3. Training of public and private sector officials.
4. Preparation of written and illustrated informational, instructional and reference publications.

D. Accomplishments to Date

The following undertakings represent some of the more recent assistance given by MSU:

1. Development of a prototype seed dryer has been completed. Information developed in the seed drying work has been integrated into a Handbook on Seed Drying.
2. A cooperative seed storage and packaging study was initiated with Owens-Illinois Corporation.
3. Submission of blueprints and further explanation to potential suppliers for the Morocco seed processing installation designed earlier.

4. Preparation of seed testing equipment for the government seed testing laboratory in Santiago, Chile.
5. USAID/Honduras. Design and specifications of facilities for seed program in Honduras.
6. USAID/Panama. Assistance and advice on Panama Accelerable Seed Program including design of layout, installation of equipment, and training of Panamanian Technicians in operational procedures.
7. Design and testing of low-cost walk-in germinators for LDC's.
8. Preparation of an illustrated handbook on "Seed Processing and Handling".
9. Routine indirect or formal assistance to USAID Missions and AID contract teams.
10. Orientation and conferences with AID-sponsored visitors.
11. Seed improvement for international participants sponsored by AID.

E. Overall Assessment

1. MSU has assembled a staff of qualified people and has qualified people on all phases of the work at MSU and overseas.
2. MSU has been responsive to all technical assistance and training requests and has provided timely and useful reports, materials and advice as well as providing supporting services to this activity from relevant university courses.
3. Judged on qualitative points, using USAID reports and the evaluation procedure outlined, MSU rates as outstanding.
4. The kind and type of technical services in terms of response and responsiveness provided the overseas program by MSU cannot be obtained from any other single source in the U.S. or elsewhere. This service has been built by AID for this purpose.

The LDC's request for technical assistance under the MSU contract have increased over the past six months. Most of these requests, as in the past, relate to technological aspects leading to investments in facilities, without economic feasibility considerations, and with inadequate consideration of investment levels, operating capital requirements and costs, and the implications of price policies upon attracting private sector investors.

The technical assistance on seed improvement by Mississippi State University is broad in scope, much broader than plant design and processing, and covers a wide range of technicality of seed development, processing and reproduction. The technical input may cover the entirety of the stages in seed improvement, or it may cover improvement of some part consistent with the entire system. Not only is design and procedure involved, but materials, machinery, procurement, training on operations and indication of possible sources of funding are also involved in this technical assistance project. To provide the technical assistance that is needed, Mississippi State employs engineers, agronomists, seed processing specialists, geneticists, and plant production technicians. Frequently, a problem may have such special requirement, in processing or because of ecological considerations, as to require the employment of consultants for short periods. In short, the assignment given Mississippi State University under this project is to set up seed improvement programs for countries, help them train people to operate the program, and help the country get a seed improvement program underway in the best manner possible.

F. Changing Seed Program Needs of the LDC's

1. Traditionally, governments have sought to establish seed processing and testing facilities, coupled with seed certification rules and training programs. Little attention has been given to the study of alternative and multiplication-distribution systems based upon the reproductive characteristics of the self-pollinated cereal grains. Even less attention has been paid to the financial, managerial and effective demand requirements of a dynamic "seed and crops improvement program."

Mississippi State University (MSU) has very effectively responded to USAID and their host government requests for technical assistance services, training and supporting research in storage problems. Over the twelve years of the Seed Processing and Testing Project existence, MSU's Seed Technology Laboratory has become a "center of excellence" in subject-matter relevant to the project. The laboratory has been used extensively by both AID-recipient countries and the U.S. seed industry. The wide spread use of MSU Contract W-607, and the rapidly increasing demand for its assistance attest to the project's effectiveness, within the framework of its conception.

2. A new dimension has been added, as a consequence of the green revolution. The new dimension for the green revolution's biological input - seed - is the economics of seed multiplication and supply systems that are responsive to the commercial crops producers needs. Correlative to this need are three other absolute necessities:

- a. The need for variety development research and extensive testing for adaptation. These must be continuous programs, designed to meet rapidly developing ecological changes.
 - b. The need for establishing viable seed multiplication-supply systems and seed industries as an element of the total agribusiness complex.
 - c. The need for delineating the producer-government-industry relationships. Such definitions are essential to bringing the full force of each sectors' capabilities and responsibilities to bear upon agricultural development opportunities, particularly as they relate to improved seed and other green revolution related productive inputs.
3. Seed Program and Policy Planning become more essential, as government attention turns to making governmental investments and/or encouraging private sector participation in farm seed enterprises.
 4. Economic and social factors affecting the establishment of seed industries in the LDC's have not been considered adequately. A major failure has resulted in all seed varieties being categorized within a single system, that is, without regard to their individual fertilization characteristics. There is a need to consider alternative systems according to four groups:
 - a. Self-fertilized - self-pollenates - which have a minimum of cross-fertilization, e.g., wheat, rice, and synthetic corn varieties.
 - b. Hybrid cereal, particularly corn and sorghum varieties.
 - c. Vegetable varieties of all kinds, usually developed for specific commodity end-use requirements.
 - d. Forage and range varieties of both grass and legumes.

The great differences in the internal economics of production-processing-storage-finance-distribution and use within these groups are critical to:

- a. Identifying potentials for domestic and/or foreign joint-venture investments, particularly in terms of capital and technological expertise.
- b. Determining location and size of the market.
- c. Considering the extent to which production and processing can, or must be, decentralized in the interest of minimizing cost-price differentials between various seed quality grades and market requirements.

Little attention has been given to each seed handling facility's role in the input supply-distribution-use system. It appears necessary to differentiate between:

- a. The small village plant that cleans locally produced seed for physical purity, and perhaps cereal seed produced locally under a certification program.
 - b. The specialized seed companies where emphasis is given to cross-pollinated varieties, especially hybrids.
5. The financial, managerial and technical manpower requirements of a seed industry are misunderstood generally. These requirements have not been subject to study in the past.

The need to deal with the financial aspects are:

- a. The tendency of governments to over-invest in equipment and structures that go under-utilized both seasonally and annually.
 - b. The lack of understanding that seed industries require large amounts of working capital, particularly if seed growers depend upon the industry to finance production and maintain reasonable inventories, including post-season reserves.
 - c. The tendency of government seed industries to unwittingly subsidize seed production-supply systems through absorption of unknown - or hidden - costs and depletion of working capital, while at the same time complaining that private seed dealers are "too expensive".
6. Institution development and organizational arrangements of a new order are needed to meet the multidisciplinary requirements of modern commercial rural economies. Commercialization of farm production is not enough, if the food needs of the urban population are to be met, either presently or for the future.

G. New Contract Instrument Needed

As presently written, Contract AID/W-607 is not truly representative of a level-of-effort contract. For this and other program reasons the relationship between AID and MSU should be redefined in a new instrument to reflect correctly AID's future needs. In order to meet both AID/W and Regional Bureau needs, the new instrument should be a cost reimbursement Basic Ordering Agreement. Under this type arrangement, either level-of-effort or completion type task orders may be placed with MSU by TAB and/or the Regional Bureaus.

Insofar as TAB needs are concerned, to the extent these can be defined specifically, a level-of-effort Task Order No. 1 can be funded to provide for MSU campus services related to some of the functions presently

called for under Contract AID/W-607; i.e., information center for questions and inquiries related to seed technology; preparation, editing and publishing of information related to seed technology; on-campus training courses and seminars; and short-term (fewer than 30 days) field assignments.

Regarding Regional Bureau needs, these can be satisfied through Mission or AID/W Regional Bureau funded level-of-effort or completion task orders, depending on the nature of the task.

To the extent deemed appropriate by TAB management, consideration also should be given to a joint Section 211(d) grant and Basic Ordering Agreement arrangement. The grant would provide funds for MSU to maintain a "center of excellence" in seed technology. Many if not all the campus functions anticipated by a TAB-funded Task Order No. 1 could be provided by MSU through grant financing. Needs for services not anticipated in the grant would be met by the issuance of Regional Bureau funded Task Orders.

While the Review and Evaluation Task Force does not recommend any one method of financing the contract (continuation of present arrangement, task orders or 211(d)), it does wish to see the contract services continued and utilized fully by Missions. Whatever type of funding is established, the missions should be informed so they are aware country funding may be required. (A Task Order approach which found Missions without available funds could reduce the utilization of the contract and jeopardize its usefulness).

H. Task Force Contract Recommendations

Based on the highly satisfactory performance of Mississippi State University and the increasing and changing needs of the LDC's (related to high-yielding varieties and the green revolution), the Task Force makes the following contract recommendations:

1. A Mississippi State University contract should continue in force and receive high priority from AID/W.
2. The name of the project should be changed from "Seed Processing and Testing" to reflect the revised scope of work as noted in #3 below.
3. The scope of work should be rewritten to enlarge the nature of services to include:
 - a. Technical assistance for seed multiplication and harvesting, seed and crop improvement programs, certification standards, marketing and distribution and packaging.
 - b. Changing seed program needs as elaborated in Section F above.

- c. Increased emphasis on training schools, seminars and on-the-job training.
 - d. Stressing private sector involvement in the seed industry and assisting LDC's in obtaining private sector cooperation.
 - e. Establish in the LDC's comprehensive education and demonstration programs in seed technology and management.
4. The prime contract should be signed with Mississippi State University, with authority granted to sub-contract with other institutions to obtain expertise in activities where they may lack competence or manpower.
 5. Contract should be written to permit MSU to make preliminary studies of resource availabilities and needs in LDC's where USAID or LDC lacks the technical capability required to either recognize the problems or propose possible solutions.

I. Task Force Recommendations for Action by TA/AGF

1. The speeches taped during the meeting May 27, 1970 on "Changing Seed-Program Needs of LDC's" should be edited and printed for distribution to all USAID's.
2. An in-depth evaluation of two Latin American country seed improvement programs should be made in countries where MSU has provided technical assistance and substantial AID project funds have been invested in establishing processing facilities. The evaluation team could consist of one technician chosen from TA/AGF and one selected by the Latin America Bureau. Countries could be chosen from the following: Panama, Ecuador, Columbia, El Salvador, Honduras.

The evaluation should pay particular attention to:

- a. Assessing the implications of seed price policies and government support services upon establishing private seed industries.
 - b. The enterprises' financial structure, e.g. investment in fixed assets, working capital availabilities, and optimal needs in terms of equity, capital and credit.
 - c. Ratio of output to rated capacity, and the effect of this ratio upon efficient use of investment and the costs added per unit/product output.
3. Sponsor a study and report of the experiences of three AID-assisted countries to provide examples of success and failure in the conception, policy, planning and execution of comprehensive seed

programs. (To do this it will be necessary to separate the "Seed Industry" into its many components, recognizing that no one scheme can be applicable to such a wide variety of plant material and range of services under different climatic, economic and political conditions). These studies should illustrate the contributions of planning and consistent follow-up to the success of the seed industry in the LDC's.

4. Assuming that any study carried out under #3 above will demonstrate the importance of pricing policies which recognize not only the cost of producing seeds but also the incentive return necessary to induce the private sector to invest in this new industry, the study should search for examples of profitability which offered sufficient inducement as well as too-low profitability. (Attitudes of officials which equate grain and seed in establishing prices are one of the main disincentives. Added technical costs for seeds are understood by some officials but the high cost of risk, particularly for the first seed growers to undertake multiplication of a new variety, is not understood.
5. If AID schedules regional meetings of Food and Agriculture Officers, Rural Development Officers or Chief Agriculturists, FA/AGF should request that adequate attention be devoted to seeds, and provide the technical staff necessary for the discussions.
6. Prepare and dispatch policy guidelines and implementation instructions to missions on all phases of the "Changing Seed Program Needs of the LDC's and on any "New Contract Instrument with MSU."

Task Force Members

Ralph E. Hansen, Consultant
 Jack H. Adams, Program Operations
 Francis J. Moncada, Contract Officer, PROC/CSD
 Theodore V. Tibbitt, Agricultural Advisor

APPENDIX VI

Summary of Contractor's Expenditures

March 18, 1958 - March 31, 1971

I. Salaries	\$784,629.98
II. Travel and Transportation	22,018.79
III. Other Direct Costs	30,513.41
IV. Equipment and Maintenance	40,904.90
V. Consultants	<u>10,451.00</u>
Total	\$894,518.08