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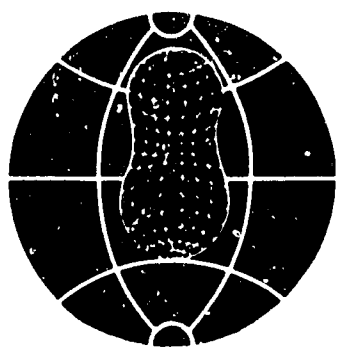
The Annual Report of the Peanut Collaborative Research Support Program (CRSP) 1982



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PREFACE

Beginning 1 July 1982 as a joint venture among the U. S. Agency for International Development (AID), U. S. universities, and host Country institutions, the Peanut Collaborative Research Support Program (CRSP) has completed a successful first year. The Peanut CRSP goal is to develop research programs for improving production and utilization of peanut, in turn enhancing the food and cash income status of farmer and urban populations in the host countries. The U. S. producers and consumers will benefit from the research findings through programs of the collaborating U. S. institutions.

The early success of the Peanut CRSP was in part due to:

- Identification of production and utilization constraints for focused research projects, and selection of U. S. and host country collaborators.
- U. S. collaborators visited host institutions in all nine countries and met with administrators and collaborators for a solid, early start.
- Excellent support received from AID missions and AID/Washington.

CRSP agreements were concluded with all the U. S. universities and most of the host country institutions, and research begun in 9 of the 11 projects. Research programs focus on breeding and varietal improvement; cultural practices; disease, insect, and mycotoxin management; soil microbiology; and food product storage, development, and utilization. Some early achievements are:

- Introduction and initial testing of a wide range of germplasm in nine host countries that could improve yields, and increase resistance to diseases, insects, and mycotoxins.
- Reciprocal introduction of elite germplasm into U. S. breeding programs.
- Assessment of the type and extent of disease, insect, and mycotoxin problems present in the host countries.
- Development of a simple process to remove aflatoxin from crude peanut oil adaptable to home or village use.
- Improvement in methodology for aflatoxin detection in peanut and diversion of contaminated peanut in processing.
- Tentative identification of two viral agents responsible for transmitting and inducing symptoms of the rosette disease.
- Identification and description of a new, potentially problematic, virus disease in peanut in the U. S., along with the development of actions necessary to control the spread of the virus.
- Development and pretesting of surveys to determine peanut consumption designed to guide future product development.
- Initial surveys to determine extent and type of mycorrhizae inhabiting peanut roots and initiation of rhizobia studies.
- Providing short-term study experiences in the U.S. for several host country researchers.

We are anticipating much progress during the second year of activity based on the groundwork laid during the first year. Thanks to all concerned who have contributed to a successful year.

David G. Cummins

David G. Cummins
Program Director, Peanut CRSP
--December 1983--

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INTRODUCTION

The peanut, Arachis hypogaea L., is an annual legume native to South America, likely originating on the eastern foothills of the Andes in the area that is now southern Bolivia and northern Argentina. It is grown in most tropical, subtropical, and temperate countries between 40 degrees north and 40 degrees south. Estimated annual production of peanut is about 18 million metric tons on 18 million hectares. More than half of the production is in developing countries, and yields are often much lower than the world average.

Peanut is an important oil, food, and feed source worldwide. An estimated 80% of the world production is extracted for cooking oil. Uses vary worldwide. For example, India the largest producer of peanut, uses essentially all the production for oil, while in some countries of Semiarid Tropical Africa over half of the production is consumed directly as food by the subsistence farmer who produced them. Peanut is well suited to production by small farmers in developing countries, but production is low and eratic.

Research needs are great. In a USAID survey, peanut research in developing countries was rated highest priority, excluding small ruminants, sorghum and millet, and bean/cowpea, to improve the well being of the small farmer in developing countries. In implementing the Peanut Collaborative Research Support Program (CRSP), the Board for International Food and Agricultural Development (BIFAD) Joint Research Committee recognized the essential role of research to relieve constraints and realize the great potential of peanut to provide food and cash income in developing countries.

The program is funded through "Title XII-Famine Prevention and Freedom from Hunger" under the "International Development and Food Assistance Act of 1975", and the participating U.S. and host country institutions. The Peanut CRSP was implemented 1 July 1983.

Features of Peanut CRSP

1. Targeted effort - Constraints were identified and targeted research objectives were established for each host country and U.S. institution. Collaborators were identified or described in the planning process.

2. Efficient design- Four U.S. universities allow for a manageable CRSP, with minimum management expenditure and maximum program expenditure.

3. Global impact - Collaboration with 9 host countries provides impact into 3 major regions; SAT Africa, Southeast Asia, and the Caribbean. Specific countries are: Senegal, Mali, Upper Volta, Niger, Nigeria, Sudan, Thailand, Philippines, and the English speaking Caribbean Countries through the Caribbean Agricultural Research and Development Institute (CARDI).

Goal

The goal of the Peanut CRSP is to:

1. Develop a peanut research base and technology-development capacity in both the U.S. and host countries.

2. Focus the resources of both developing country and U. S. research institutions into a long term collaborative research program to relieve constraints to peanut production and utilization.

Objectives

General

The Peanut CRSP has two general objectives common to all projects.

1. Enhance research programs in the U.S. and host country institutions through
   - development of cultivars, management practices, and utilization processes that would lower costs and enhance peanut use
   - support of programs in terms of equipment, supplies, and personnel.

2. Improve the research capability of host country institutions by
   - offering short term and degree oriented training programs for host country staff at U.S. institutions
   - providing on-site consultation in the host countries by U.S. scientists
   - providing program support of equipment, supplies, in -country travel, and personnel.

Specific

The specific research objectives of the projects that comprise the Peanut CRSP were developed around prioritized constraints identified during the planning process. These constraints, program strategy, and research projects designed to gain information to relieve them follow.

1. Constraint identification. - During the planning of the Peanut CRSP, 13 potential constraints to peanut production and utilization were identified. Questionaires were widely distributed in the U.S. and around the world; a representative response was received. The Planning Grant Panel and Team evaluated the responses and summarized the most important researchable constraints. Six constraint areas were included in the CRSP plan, which were reviewed and approved by BIFAD for the CRSP. The constraints are:
   a. low yields because of unadapted varieties and lack of varietal resistance to diseases, insects, and drought;
   b. health hazards and economic losses due to mycotoxin contamination;
   c. yield losses due to infestations of weeds, insects, diseases, and nematodes;
   d. food supplies inadequate and peanuts are not generally considered a primary food source;
   e. economic and sociological problems preventing efficient production and utilization;
   f. physiological and soil microbiological barriers to higher yields.

2. Program Strategy - The individual Peanut CRSP projects are designed with host country needs in the forefront, but at the same time focusing on regional problems. Information is shared on a regional basis by means of reports, publications, and appropriate meetings. An international scope will be assured through information exchange and close coordination with International Agricultural Research Centers, World Bank, United Nations Organizations, and other AID programs from developed countries. Formal linkages will be developed with the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) to avoid program duplication or unnecessary overlap and insure maximum complementarity.

3. Relationship of research projects targeted to peanut production and utilization constraints in developing countries.

	Constraints					
Research Projects	Low yielding cultivars	Health hazards from mycotoxins	Yield losses from pests	Inadequate food supplies	Economic problems	Soil Micro-biological barriers
Econ survey					1	
GA/INPEP	1*					
TX/BCP/S	1	2**	1			
TX/MM/S		1				
GA/PV/N			1			
AAM/FT/S		2		1	2	
NCS/BCP/TP	1		1			2
NCS/IM/TP			1			
GA/IM/UV						
GA/FT/TP		2		1	2	
AAM(FL)FT/CAR		2		1	2	
NCS/TX/SM/TP						1

*1-primary project objective. **2-secondary project objective.

Project codes identification:

Economic survey- Short term studies to be contracted by Management Entity.

GA/INPEP- International Peanut Evaluation Program to introduce and test advanced lines and varieties in Niger, Mali, Upper Volta and Caribbean by UGA.

TX/BCP/S- Breeding peanuts for resistance to foliar and soil-borne diseases in Senegal by TAMU.

TX/MM/S- Mycotoxin management in peanuts by prevention of contamination in Senegal by TAMU.

GA/PV/N- Peanut viruses: etiology, epidemiology, and nature of resistance in Nigeria by UGA.

AAM/FS/S- An interdisciplinary approach to optimum food utility of peanuts in Sudan by AAMU.

NCS/BCP/TP- Peanut varietal improvement for Thailand and Philippines by NCSU.

NCS/IM/TP- Management of arthropods on peanuts in Thailand and Philippines by NCSU.

GA/IM/UV- IPM strategies for groundnut insects in Upper Volta by UGA.

GA/FT/TP- Consumption of peanuts as food and appropriate technology for storage/utilization in Thailand and Philippines by UGA.

AAM(FL)/FT/CAR- Peanut utilization in food systems in the Caribbean by AAMU/UFL.

NCS/TX/SM/TP- Rhizobia and mycorrhizae influence on nitrogen fixation and growth of peanuts in Thailand and Philippines by NCSU/TAMU.

MANAGEMENT ORGANIZATION AND ACCOMPLISHMENTS

In anticipation of the Peanut CRSP grant award, the institutional representatives of the participating U.S. institutions met near the end of the planning grant in April 1982 and elected the University of Georgia as Management Entity and approved the Program Director designee. Implementation plans were begun during the interim between the planning and research grants, 30 April to 11 August (retroactive to 1 July) 1982. A Board of Directors, Technical Committee, External Evaluation Panel, and AID personnel will advise and guide the Management Entity in areas of policy, technical aspects, budget management, and review.

Management Entity

Responsibilities

The University of Georgia Management Entity office is located in the College of Agriculture at the Georgia Station, Experiment, Georgia. The major role is responsibility to AID for technical and administrative matters for the CRSP. Duties include negotiating agreements, fiscal management, progress reports, and project modification.

Organization

The Management Entity staff (CRSP financed) is comprised of:

Dr. David G. Cummins, Program Director
Mrs. Barbara Donehoo, Administrative Secretary

Supportive Management staff (non CRSP financed):

Mr. Ted Proffer, Business Manager, University of Georgia College of Agriculture
Dr. Darl Snyder, Director of International Development and Title XII Representative, University of Georgia.

Accomplishments.

- Offices and equipment from the planning grant were maintained for the Management Entity.
- Developed and signed subgrants and project Plans of Work with Alabama A&M University, University of Georgia, North Carolina State University, and Texas A&M University.
- Prepared Memoranda of Understanding and project Plans of Work for host country agreements and Program Director traveled to the nine host countries with principal U.S. investigators to conclude the agreements (the 10th country, Cameroon, was visited but due to a change in program needs, the project was shifted to Upper Volta).
- Planned and hosted two Board of Director meetings.
- Participated in Program Director and Board Chairman meeting held by AID in Washington, D.C.
- Published one issue of a Newsletter.
- Provided support to the Principal Investigators in their project organization and initiation.
- Planned and contracted for short-term Economic Studies in Sudan, Thailand, and the Philippines. Surveys were accomplished in these countries.
- Interfaced with ICRISAT Director for International Programs on Africa research plans.

Board of Directors

Responsibilities

The Board of Directors serves in an advisory role to the Management Entity and provides liaison to their respective institutions. The duties of the Board of Directors are to establish policy for the CRSP, approve annual budgets, approve recommendations on programs, and review accomplishments of the CRSP.

Organization

The Board consists of one administrative representative from each of the participating U.S. institutions (4) and from ICRISAT for a total of 5 members. The length of term of members is at the discretion of the individual institutions. A chairman and secretary is elected.

The present board is:

Dr. Dudley T. Smith
(Board Chairman)
Associate Director
Texas Agricultural Experiment Stations
Texas A&M University

Dr. E. Broadus Browne
(Board Secretary)
Director, Georgia Agricultural
Experiment Stations
University of Georgia

Dr. B. Onuma Okezie
Director of International Programs
Alabama A&M University

Dr. Billy E. Caldwell
Head, Department of Crop Science
North Carolina State University

Dr. Ron W. Gibbons
Groundnut Program Leader
ICRISAT

Accomplishments

The Board of Directors met twice during the year to review programs and take action on priority issues.

- Organized Board and developed operating procedures.
- Confirmed Technical Committee members.
- Developed CRSP policies on travel clearance, financial management, and related issues.
- Developed and approved documents for Subgrants, Memoranda of Understanding, and Plans of Work establishing relationships between the Management Entity, Participating U.S. Institutions, and Host Country Institutions.
- Determined role and makeup of External Evaluation Panel.
- Reviewed cost sharing policies of CRSP and assured compliance.

Technical Committee

Responsibilities

The Technical Committee acts in an advisory role to the Board of Directors and Management Entity. Primary duties are to review and recommend plans for research, training, and budgetary components of the projects, establish mechanisms for program coordination in host countries, and assist in planning annual reviews.

Organization

The committee consists of one principal investigator from each participating U.S. institution.

The present Technical Committee is:

Dr. Johnny C. Wynne
Department of Crop Science
North Carolina State University

Dr. Bharat Singh
Department of Food Science
Alabama A&M University

Dr. James W. Demski
Department of Plant Pathology
Georgia Experiment Station
University of Georgia

Dr. Olin D. Smith
Department of Soil &
Crop Science
Texas A&M University

The Program Director/Administrative Secretary of the Management Entity serves as secretary to the committee.

Accomplishments

The Technical Committee formally met shortly afrer the close of the first year. The members individually advised the Board and Program Director on several occassions. Items of concern were:

- Liaison with other Principal Investigators during development of Memoranda of Understanding and Plans of Work.
- Organizing travel to host countries for negotiating agreements.
- Discussing program initiation in the host countries and adequacy of budgets.
- Plan for official meeting in July 1983.
- Travel coordination to have investigators attend to needs on projects other than their own.
- Technical program coordination, content, and location.

External Evaluation Panel

The External Evaluation Panel was described in the CRSP Plan to consist of 3 to 5 eminent scientists recommended by the Management Entity for review and approval by AID. Their role is to monitor and evaluate program direction and accomplishments. Duties include a review of projects and programs of the CRSP and provide written evaluation, and recommendation for addition, elimination, or modification of component projects and overall objectives to include retention, elimination, or addition of new overseas sites. Preliminary plans for the Panel have been discussed. At present, a Panel is being formed in consultation with the AID Project Manager and BIFAD representative.

Coordination with AID and BIFAD

AID - Liaison is maintained with AID on a continuing basis for advice in program direction and development, securing travel approval, clearances for equipment purchases, coordination with mission programs, and submittal and approval of various reports.

Dr. Loren Schulze is the AID Peanut CRSP Project Manager.

BIFAD - Advice is provided by BIFAD in various areas of concern in program development and management. The CRSP maintains a liaison with BIFAD.

Mr. William Fred Johnson is the BIFAD liaison to the CRSP.

Peanut CRSP-ICRISAT Program Analysis/Coordination

The CRSP Plan calls for an annual conference with appropriate ICRISAT personnel to analyze the peanut research programs of the two groups to avoid duplications or CRSP substitutions for ICRISAT responsibilities. Programs of both groups emphasize Semiarid Tropical regions and a common funding source contributes to the need for such an analysis. Joint plans will insure maximum results from research efforts.

Dr. David G. Cummins, Program Director, met in Paris with Dr. C. R. Jackson, Director for International Program at ICRISAT, while enroute to Niger and other countries to negotiate project agreements. Major discussion surrounded ICRISAT plans for peanut research at the new Sahelian Center near Niamey, which could have implications on the CRSP program. The CRSP project in Niger concerns variety improvement through introduction and testing of advanced lines and varieties. The following points summarize the discussion.

- ICRISAT presently staffs sorghum and millet researchers at the Sahelian Center. Plans call for 2 or 3 peanut researchers (breeder and pathologist) in Niger, but due to fund restrictions this may be delayed.
- The CRSP input in variety development will be at the INRAN station at Maradi (eastern Niger in peanut production region) and there is a possibility that the ICRISAT scientists may be located at Maradi.
- Discussed the possibility of joint support for a native scientist to work in Niger under the direction of the sorghum and millet breeder with responsibility to evaluate a wide range of germplasm for SAT Africa. Support costs may prohibit this at present.
- ICRISAT plans are so tentative at this point that the CRSP relationship with Niger must be negotiated as planned.

PROGRAM SUPPORT

The Peanut CRSP grant from AID provided $900,000 for the period 1 July 1982 to 30 June 1983. In addition $116,723 was pledged by the U. S. institutions as their non-federal cost sharing contribution to the program. U.S. participating institutions are required to contribute not less than 25% of the total support to CRSP projects, except for Management Entity and Host Country activity cost. Table 1 summarizes the distribution of these funds.

Table 1. Summary of sources of support for the Peanut CRSP, 1 July 1982 to 30 June 1983.

Item	Budgeted	Expended
AID Program		
Cost Shared	301,316	101,373
Not Cost Shared	215,658	39,443
Total	516,974	140,816
Mgt. Entity	360,255	176,041
Total	877,229	316,858
University Support	116,723	98,011
Grant Total	993,952	414,869

Table 2 shows the amount of Cost Shared and Not Cost Shared funds, and the Total Cost Sharing expended by projects during the year. Cost Shared funds are expended directly on behalf of the U.S. institutions, while the Not Cost Shared funds are expended by or on behalf of the Host Country institutions. Expenditures were relatively low, especially the Not Cost Shared portion, due agreements being completed and programs initiated late in the budget year. Also, this prevented having an estimate of Host Country contributions to the program. Agreements were concluded and research initiated on some of projects that were scheduled for funding 1 July 1983. Some expenditures were made on these projects prior to 1 July 1983 and are reported in Table 2.

Table 2. Allocation of AID Program funds in 1982.

Project	Award Amount	Expended		
		U. S.	Host Country	Total
1982 Budget	AID Program Funds			
GA/INPEP	85,718	9,716	10,000	19,716
TX/BCP/S	136,095	11,344	0	11,344
TX/MM/S	90,686	32,790	0	32,790
GA/PV/N	60,222	33,949	6,748	40,697
AAM/FT/S	83,733	0	0	(8,373)*
NCS/BCP/TP	60,520	13,574	22,695	36,269
Total	516,974	101,373	39,443	140,816
University Support	116,723	98,011	------	98,011
1983 Advance**				
GA/FT/TP	94,564	5,269	3,915	9,184
University Support	31,671	7,500	-----	7,500

*Advanced but not included in expenditures.
**Scheduled for initiation 1 July 1983.

Tables 3 and 4 show amounts budgeted and expended by line item for the projects or program and for the Management Entity.

Table 3. AID Program funds budgeted and expended by line item in 1982.

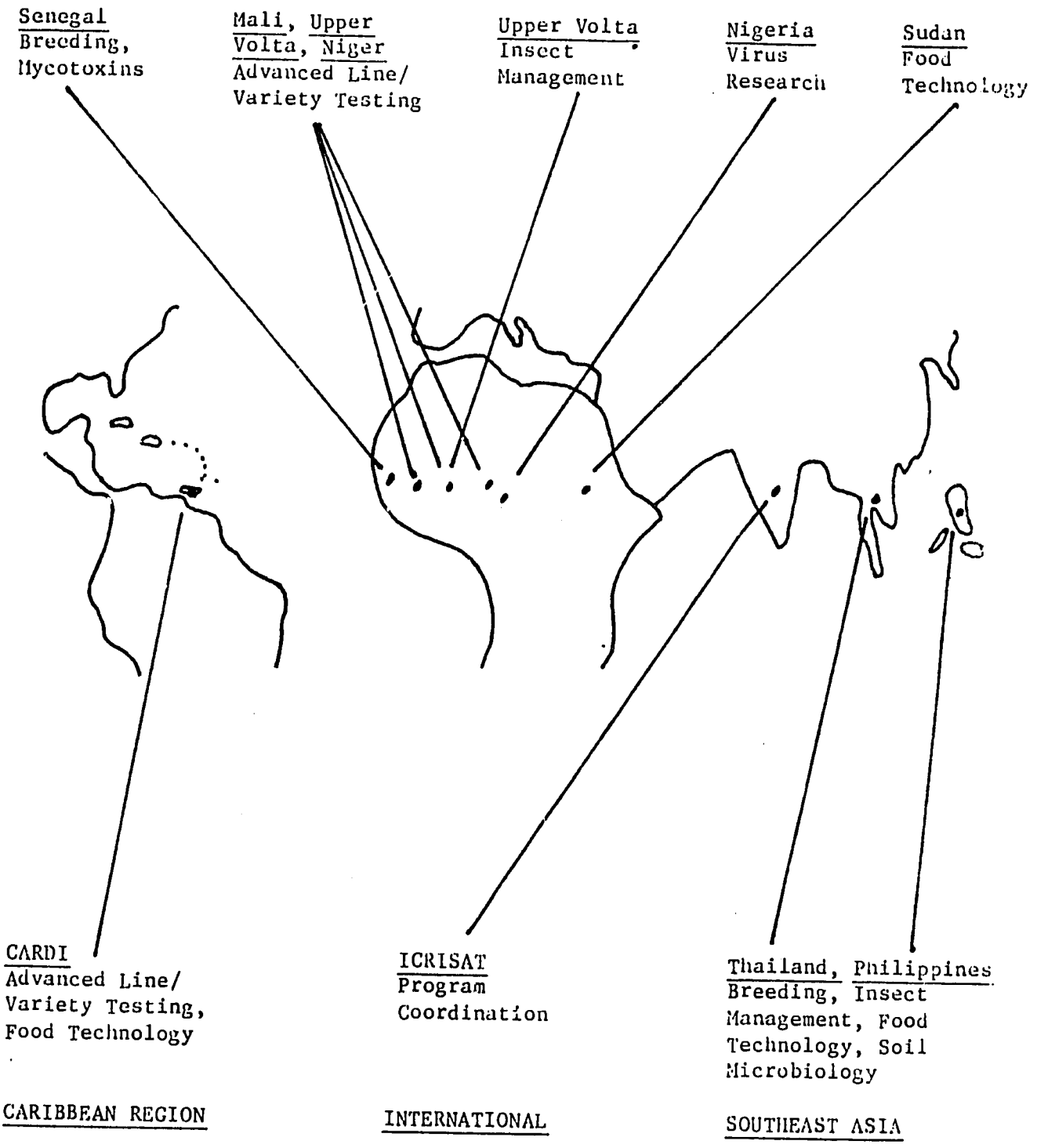
Item	Budgeted	Expended	Budgeted	Expended
	1982 Budget		1983 Advance	
Salaries	123,058	32,819	16,533	2,268
Equipment	28,042	6,104	0	209
Travel	45,209	20,960	9,000	1,384
Supplies	25,495	15,262	2,623	225
Other	16,734	1,287	13,307	0
Indirect Costs	62,778	24,940	22,101	1,183
Total	301,316	101,372	63,564	5,269
Subagreements with LDC institutions	215,658	39,443	31,000	3,915
Total	516,974	140,815	94,564	9,184

Table 4. Management Entity costs for 1982.

Item	Budgeted	Expended
Salaries	62,000	59,764
Staff Benefits	14,000	12,119
Supplies and Equipment	5,000	4,227
Travel	20,000	13,972
Communication	5,000	2,298
Meeting Costs	10,000	6,493
Research Newsletter	5,000	0
Contract Studies	120,000	3,953
ME Total	241,000	102,826
ME Indirect	73,505	31,362
Sub Contract Indirect	45,750	41,854
Total	360,255	176,042

GLOBAL NATURE OF PEANUT CRSP

SEMIARID TROPICAL AFRICA



INTRODUCTION TO ANNUAL REPORTS

Subgrant Agreements and project Plans of Work were concluded with the four universities and for the eleven projects, which enabled active involvment of the principal investigators in negotiating agreements with the Host Countries and initiating research both in the U.S. and Host Countries. All the locations (see chart on previous page) are within the region bounded by 11^0 and 17^0 north.

Memoranda of Understanding were signed with seven of the nine Host Countries prior to June 30. Exceptions are Senegal and Mali where some internal delays have been experienced, but completion is expected soon. Host Country Plans of Work were signed prior to June 30 for nine of the eleven projects (exceptions were the two projects in Senegal). The Mali agreement for the multi-country Advanced Line/Variety Testing project has not been signed.

Travel to the Host Countries late in the Planning Grant or early in the Research Grant by U.S. Principal Investigators to meet with their counterpart researchers enabled significant research to be initiated in the host countries during the growing season of 1982. Research began in nine of the eleven projects during the first year, with work started ahead of the scheduled 1 July 1983 initiation date in three of these. The Board of Directors agreed that reasonable funds could be expended in the U.S. to initiate projects and assist in concluding Host Country agreements.

Project annual reports for FY 82 (1 July 82 to 30 June 83) follow. Reports are included for the 6 projects scheduled to begin in 1982, and for the 5 projects scheduled for initiation in 1983 but where significant progress was made in 1982.

Note: The project "Rhizobia and Mycorrhizae Influence on Nitrogen Fixation and Growth of Peanut in Thailand and the Philippines" is a cooperative project between North Carolina State University and Texas A&M University. The investigators from the respective institutions have both independent and cooperative objectives in the areas of rhizobia and mycorrhizae research. Financial support is provided to each insitution directly, while all funds for Thailand and Philippines flow through North Carolina State for convenience since the same host country departments are involved. Separate annual reports are presented (beginning on pages 65 and 72) in order to fully describe the input of each University in implementing the research program.

"International Peanut Evaluation Program"

University of Georgia - Niger, Mali, Upper Volta, Caribbean

W.D. Branch and R.O. Hammons, Co-Principal Investigators, UGA

INTRODUCTION

Because of expanding hunger in the less developed countries around the world and because of the subsistence role of the cultivated peanut (Arachis hypogaea L.) in West Africa and Caribbean Community, a variety testing project was proposed and funded as one of several priority research areas under the Peanut CRSP to improve the food supply that is contributed by existing varieties. In these areas, research support is not adequate to fully finance an active breeding program, but the evaluation of new germplasm can feasibly be conducted at several locations with relatively short-term beneficial results.

MAJOR ACCOMPLISHMENTS

Establishment of Project

Beginning in 1982, an International Peanut Evaluation Program (INPEP) was established for a proposed five-year period. The University of Georgia College of Agriculture will serve as the formal U.S. institution with the host countries of Niger, Upper Volta, Mali, St. Kitts, St. Vincent, Jamaica, and Belize. Informal agreements for variety testing also have been made with Cameroon, Thailand, and the Philippines.

Research Results

In the spring of 1982, 30 U.S. released cultivars (Group 1) were forwarded to Cameroon, Niger, Mali, and CARDI. These were planted for initial observation and screened for adaptation during the growing season. The "best-fit" selected lines plus local check varieties were advanced to a statistically designed test in 1983.

The short (ca. 90 day) rainy season excluded late-maturing entries in West Africa, and because of hand-harvesting procedures, only erect plant types are being chosen in the Caribbean. Thus, a one-year screening period appears to be worthwhile when introducing germplasm into a different environment.

In the spring of 1983, 80 U.S. unreleased breeding lines (Group II) were sent to Niger, Cameroon, and CARDI for the first-year observational period. Also, Group I material was redistributed to Upper Volta, Thailand, and the Philippines (via North Carolina State University CRSP project for the latter two countries). The additional locations have broadened the evaluation base and strengthened the overall testing program.

EXPECTED IMPACT OF PROJECT

Peanut production constraints are numerous and resources limited for the small-scale farmers in these countries. However, the introduction, evaluation, and identification of improved varieties should potentially result

in an increase of food yield without a significant change in traditional farming systems. At the same time, it should maintain the viability of this particular crop in regions where its nutritional value is of paramount importance.

The acquistion of elite peanut germplasm from world breeding programs for use in the U.S. can be more readily obtained through such a program. To date, some 250 advanced breeding stocks have been assembled from this project. Also, the information gained from testing in diverse environments should be of scientific interest to all concerned.

GOAL

The overall goal of this project is to improve peanut production in the host countries through the introduction of superior germplasm by means of an advanced line/variety testing program.

OBJECTIVES

The primary objectives are:

1. Introduce and test advanced lines and varieties of peanut.

2. Assist in seed increase of superior germplasm and encourage distribution to farmers.

3. Compile results regarding genotype, environment, and genotype x environment interactions to aid in further genetic improvement.

Approach

Under this program, collaborative research will be conducted by U.S. and participating nation scientists to identify superior performing genotypes adapted to each particular country. U.S. cooperators will provide general leadership in obtaining advanced-generation breeding lines and varieties from around the world, increasing the selected test material at the Coastal Plain Experiment Station, and subsequent distribution to host countries. Each investigator will be responsible for actual replicated field testing using cultural practices which are acceptable to farmers of that area. Performance data will be analyzed, compiled, and published in the U.S., and then the results disseminated to all cooperators. Any variety and/or experimental line found to be desirable within this program will be subject to an international release between the originating institution and the host country.

ORGANIZATION

University of Georgia

Dr. W.D. Branch, Co-Principal Investigator, Department of Agronomy, Coastal Plain Station, Tifton, Plant Breeder.
Dr. R.O. Hammons, Co-Principal Investigator, USDA/ARS and Department of Agronomy, Coastal Plain Station, Tifton, Plant Breeder.

Niger

l'Institut National de Recherches Agronomiques du Niger (INRAN)
Dr. Moussa Saley, Director General
Dr. Amadou Mounkaila, Research Collaborator

Mali

1 Institut d'Economie Rurale (IER)
Mr. Deilmoussa Soumano, Research Collaborator

Upper Volta

l'Institut Superieur Polytechnique (ISP)
Dr. Laya Sawadogo, Director
Dr. Philip Sankara, Research Collaborator

Caribbean

Caribbean Agricultural Research and Development Institute (CARDI), University of West Indies Campus, St. Augustine, Trinidad
Dr. Syed Q. Haque, Research Collaborator

ACCOMPLISHMENTS IN DETAIL

1. Detailed results of the 1982 seed increase plots will not be presented. Unreplicated rows were planted and best adapted varieties from these will be included in the 1983 replicated trials. Pertinent observations such as disease resistance and maturity were made.

2. Mr. Adamou Mounkaila, Niger collaborator, came to the U.S. in July 1983 for a training period. His time was limited because it was during the growing season in Niger, and he could not leave his research for very long. He attended the American Peanut Research and Education Society annual meeting 11-14 July. This enable him to hear presentations on current research, obtain various published materials, and meet and talk with peanut researchers. He spent the following week at Tifton, Georgia to study research techniques and discuss research plans with the U.S. investigators.

PLANS FOR 1983

Additional seed for increase was sent to the collaborators in 1983. These will be increased in the same manner as in 1982. As the project progresses the base of new adapted germplasm in the country will increase, and replicated tests will be conducted. The 1984 tests will include the best materials from 1982 and 1983 increases.

Short-term training in the U.S. for host country collaborators will continue. Coordination and consultation visits to the host country locations will be made by the principal investigators.

"Disease Resistant Peanut Varieties for Semi-Arid Environments"

Texas A&M University - Institut Senegalais de Recherches Agricoles

O.D. Smith, Principal Investigator, TAMU

INTRODUCTION

Agreements allowing initiation of the project were signed in early 1983 but official approval of final documents allowing complete LDC and Texas A&M University collaboration are still pending. The project is aimed at increasing and stabilizing peanut yields by the development of disease resistant cultivars and/or improved cultural practices for the semi-arid Sahelian environments. Peanut germplasm used and selected in the Texas breeding program will be evaluated for its usefulness per se, and in combinations with cultivars and breeding materials of the ISRA to address important constraints to peanut production. Population development and early generation screening in Texas will be used to supplement that which can be done in Senegal.

MAJOR ACCOMPLISHMENTS

Establishment of Project

Initial funding for the project became available in February 1983, after approval of the Subgrant and Plan of Work between the CRSP management entity and Texas A&M University. French and English translations of the Memorandums of Understanding have been prepared and final approval is anticipated between Senegal, CRSP Management, and Texas A&M University. Resignation of the host country principal investigator from his position in Senegal has caused some delay in project implementation. However, a new investigator has been designated and project review and planning with him will be forthcoming soon.

Research Results

In anticipation of project approval and subsequent allocations of funds, preliminary tests and exchanges of seed were initiated prior to the 1982 growing season. These included:

(a) Seed of 115 Texas breeding lines and cultivars were sent to CNRA/ISRA for seed increase for future tests. Preliminary leafspot disease ratings were obtained during the initial seed increase.
(b) Eight Texas breeding lines that had been selected for leafspot resistance produced pod yields ranging from 68 to 92% of the mean of six local checks, and 2 were in the highest statistical yield group. However, the leafspot ratings of the lines did not differ from the local checks.
(c) Seed of eight Senegalese cultivars and parental lines was increased in Texas. Susceptibility of the cultivars to some important soilborne pathogens in Texas was confirmed by field diagnosis and isolation of specific fungal pathogens.
(d) Macrophomina phaseolina, the causal agent of charcoal rot, was the most frequently isolated pathogen of dried pods collected from bulk storage facilities in Senegal. Other fungi isolated from dried pods collected in Senegal were: Aspergillus flavus, Rhizoctonia solani, and a Sclerotinia sp.

(e) A preliminary study of foliar disease assessment methods amenable to the establishment of uniform evaluation methods in Texas and Senegal was initiated.
(f) Preliminary comparisons were made of six cultivars being considered as standard maturity references in international evaluations.

EXPECTED IMPACT OF PROJECT

The potential impact of the project on peanut production in Senegal and West Africa is contingent upon the adaptation of the Texas germplasm to those production conditions, and its resistance to the production constraints of that region. The preliminary seed increase and test was conducted under atypical, water-supplemented conditions. The adaptation appeared reasonable based upon yields but tests under more typical production conditions will be required.

The identification and recognition of the relative importance of soilborne diseases in Senegal is important. If soilborne diseases are causing significant production losses, the Texas germplasm could be quite beneficial. Parents and breeding lines selected originally for resistance to Pythium and Rhizoctonia spp. have been found to resist Sclerotium rolfsii, Sclerotinia minor, and, to some extent, Cylindrocladium crotalariae. Thus, it seems reasonable to expect that it could be useful for reducing losses to soilborne diseases in Senegal.

The impact of the project to Texas will include access to new germplasm, especially that developed for drought resistance, evaluation of Texas breeding materials under a broader range of environments, and broadened experience by the Texas researchers.

GOAL

To identify or develop peanut lines adapted to nonirrigated production in drought prone environments that have resistance to pathogens causing economic loss, and to identify cultural practices that will maximize the yield potential of cultivars fitted to these environments.

OBJECTIVES

A. Identify the major pathogens associated with soilborne diseases and the conditions under which they develop.

B. Determine the seasonal development and relative abundance of foliar disease epidemics to maximize the effectiveness of field screening.

C. Evaluate Texas breeding lines for adaptability, disease reactions, and acceptability for use as cultivars in Senegal.

D. Provide opportunity for training Senegalese staff and students.

E. Develop new populations by hybridization, select, and evaluate lines of potential benefit under Senegal and Texas growing conditions.

F. Increase seed of select lines for distribution and production.

Approach

1. Plant Texas breeding lines and Senegalese cultivars in Senegal to determine if Texas lines are adapted to the Senegal environment.

2. Evaluate Senegalese germplasm in Texas to determine adaptability to US conditions and to establish a basis for making appropriate selections.

3. Make on-farm field examinations and diagnoses of foliar and soilborne diseases in the major peanut production areas of Senegal. Collect samples for laboratory verification of field diagnoses.

4. Select parental lines and make crosses to combine desirable traits.

5. Evaluate Texas breeding material under field conditions in Senegal and in Texas, and in the laboratory where feasible, for reactions to important foliar and soilborne diseases.

6. Identify evaluation techniques and standards that will facilitate communication and enhance national and international collaborative research.

7. Provide educational and training opportunities for Senegalese collaborators and support personnel.

ORGANIZATION

TEXAS A&M UNIVERSITY

Dr. O.D. Smith, Principal Investigator, Dept. of Soil & Crop Sciences, College Station, Breeder
Dr. C.E. Simpson, Cooperator, TAMU Research & Extension Center at Stephenville, Breeder
Dr. D.H. Smith, & Dr. T.E. Boswell, Cooperators, TAMU Plant Disease Research Station at Yoakum, Plant Pathologists
Dr. R.E. Pettit, & Mrs. R.A. Taber, Cooperators, Dept. of Plant Pathology, College Station, Plant Pathologists

Institut Senegalais De Recherches Agricoles (ISRA)

Dr. I. Thiongane, Le Director General, Dakar
Dr. M. M'Bodj, Le Director, Centre Nord De Recherches Agricoles (CNRA), ISRA, Bambey
Dr. J.C. Mortreuil, CNRA/ISRA, Bambey.

ACCOMPLISHMENTS IN DETAIL

Eight Texas spanish-type breeding lines, two Texas cultivars, and six Senegal checks were tested for yield, grade, and reaction to leafspot in a replicated test at Bambey, Senegal. The two Texas check cultivars, Tamnut 74 and Starr, and two breeding lines were in the highest statistical yield group with five of the Senegalese checks. All eight Texas lines were in the top group for vine production. The leafspot ratings (ICRISAT method) of Texas lines at 75, 90, and 105 days after planting were generally within the range of the local checks. Tamnut 74 rated poorer than the other entries at 75 and 90 days.

Seed of 115 additional breeding lines and cultivars were increased in Senegal for future testing. The lines were chosen for increase because of soilborne disease resistance (42 lines), leafspot resistance (59 lines), earliness (9 lines), and yield potential. The lines were grown at CNRA, Bambey under supplemental irrigation. Seed were harvested for planting in 1983. Leafspot ratings (ICRISAT method) were obtained at 77 and 104 days after planting in the nonreplicated seed increase plots. Twenty-two lines had 10% or less defoliation at 104 days after planting and defoliation exceeded 50% in 49 lines.

Six hundred and thirty dried peanut pods collected in Senegal during the winter months of 1982 and 1983 were plated on culture media for analyses of fungal infection. The pods were collected from bulk storage silos near Kaolack and west of Bambey, and at the CNRA/ISRA at Bambey. Shells and kernels from each pod were plated separately on rose bengal and malt-salt media at room temperature and the predominant fungi identified. The percentage of shells and kernels infected by the fungi were as follows:

Genus	Kernels infected (%)	Shells infected (%)
Macrophomina	45	83
Penicillia	65	36
Thielavia	25	60
A. flavus	15	4
Rhizoctonia	3	4
Sclerotinia	1%	1%
Other	57	80

The frequent occurrence of Macrophominia in these specimens suggest that attention should be given to this pathogen (which thrives under dry, high temperature conditions) to ascertain its importance in production areas near the collection sites. Thielava was found in more than half of the shells. No Pythium and limited Rhizoctonia infections were apparent.

Fifty seed of eight Senegalese cultivars were received in Texas and field increased. Pod disease severely restricted the productivity of the lines so that only 500-600 seed each were obtained. Pod decay, rated on a 0 (no decay) to 9 (90% or more decay) basis, of the Senegalese cultivars ranged from 30 to 90% as compared to 70 and 40% for Early Bunch and Florunner, respectively. Fungi identified from platings of representative pod samples of the entries were as follows:

Genus	Kernels infected (%)	Shells infected (%)
Macrophomina	8	8
Penicillia	55	95
Thielavia	1	1
A. flavus	1	1
Rhizoctonia	20	20
Sclerotinia	0	0
Other	15	20

Macrophomina was less and Rhizoctonia more prevalent in these pods than in those from Senegal.

Replicated yield, grade, and pod disease evaluations were made on 50 breeding lines and checks at two Texas locations where soilborne disease was prevalent. Modified bulk and plant row selections were made from segregating populations for additional line development and testing. Particular emphasis was given to selection for thin shells with minimal pod disease.

The identification of peanut varieties or lines that can effectively be used for maturity references to aid international evaluation and communication was initiated in consultation with Dr. R.O. Hammons. Six cultivars (Chico, Starr, Early Bunch, Florunner, Virginia 72R, and Tifton 8) were chosen for initial evaluations. Preliminary comparisons were confounded by pod disease which triggered a delayed pod set in some lines.

Ten seed each of 43 lines, selected as drouth tolerant at ICRISAT, were obtained for seed increase through Dr. D.L. Ketring, ARS/USDA Stillwater, OK. These will be multiplied for evaluation and population development. An additional 36 bunch and 18 runner-type lines were selected from the leafspot resistance program for increase and future testing in Senegal and Texas.

Three replicate samples of 10 seeds each from 60 breeding lines have been examined for their ability to resist A. parasiticus penetration in controlled humidity chambers. The F_6 breeding lines were progeny from crosses of P.I. 337409, P.I. 337394, UF 73-4022, Tamnut-74, Florunner, and Toalson. Seed with intact seed coats were incubated in chambers with 95% R.H. for approximately 18 days. Following incubation the seeds were rated for the severity of seed colonization, and seed of each line was analyzed for aflatoxin content. Several of the lines had less than 50% seed colonization and a limited number exhibited less than 35% colonization. A few lines heavily invaded by A. parasiticus, however, contained relatively low levels of aflatoxin compared to other lines. The majority of the breeding lines contained more than 2,000 parts per billion aflatoxin. A few lines had a relatively low level of colonization and a relatively low level of aflatoxin contamination. Some variability was noted between replications and a controlled environmental chamber is under construction to reduce the variability in future tests. These results indicate that some of the resistant seedcoat features noted in the P.I.'s 337409, and 337394, and UF 73-4022 can be incorporated into breeding lines which have superior yielding potential.

Modification of a 20 x 40 foot fiberglass covered house is nearing completion. This structure will be used to isolate newly introduced germplasm. A pipe frame screenhouse 17 ft x 38 ft has been erected inside the fiberglass house. Seed and vegetatively propagated plant material will be initially increased in this structure where material can be inspected for disease symptoms and entry of potential insect vectors can be prevented or minimized.

PLANS FOR 1983

Obtain final approval of Memorandum of Understanding and Plan of Work between host and U.S. institutions.

Evaluate and compare breeding lines from Texas and Senegal for reaction to the major peanut pathogens in each country and for adaptability in multiple locations for exposure to the various environments, soil types, and pathogens. Data will include pathogen identification and prevalence; disease ratings of roots, pods, and foliage; yield; market quality; and economic value. Standardized disease evaluation techniques will be used in both countries where possible. Select lines for further evaluation and for parents in crosses.

Make on-site examinations in a representative cross-section of the peanut production areas in Senegal to ascertain the incidence and prevalence of soilborne and foliar pathogens, and to observe the cultural and management practices employed. Laboratory assessments will be used to confirm on-site diagnoses of diseases.

Evaluate rapid screening methods as detached leaf inoculations in dew chamber, multiple innoculations on intact plants, and sporulation measures to refine expertise and select techniques for use on populations segregating for disease resistance.

Compare field performances of 10 Texas peanut cultivars or lines with differing disease reaction or agronomic traits at 4 locations in Texas (Yoakum, Stephenville, Bryan, and El Paso). Pod and foliar diseases will be assessed. Selected Senegalese cultivars which are currently being increased in Texas will be added to the summer 1984 test. Of special interest will be the performance of cultivars at El Paso, where saline soils and drought conditions are common.

Tolerance of selected Texas and Senegalese cultivars to Aspergillus niger seedling disease will be determined in the greenhouse.

Peanut cultivars and breeding lines with proven resistance to soilborne pathogens such as Rhizoctonia solani, Sclerotium rolfsii and Pythium myriotylum will be planted in box plots and inoculated with a Texas isolate of the charcoal rot pathogen Macrophomina phaseolina and the degree of resistance to root and pod rot determined.

Seed of breeding lines derived from crosses of Aspergillus flavus and A. parasiticus resistant x adapted susceptible parent crosses will be screened for resistance to those fungi. Selections on the basis of fungal growth, supported by aflatoxin analyses, will be evaluated for acceptability per se or as parents.

Obtain and increase drought and disease resistant germplasm for evaluation and possible use in breeding.

Provide opportunities for training during on-site visits, and by short-term technical and graduate training programs in the U.S.

"Mycotoxin Management in Peanut
by Prevention of Contamination and Monitoring"

Texas A&M University - Institut Senegalais De Recherches Agricoles

Robert E. Pettit, Principal Investigator, TAMU

INTRODUCTION

There is an urgent need to reduce the severity of mycotoxin (eg. aflatoxin) contamination of peanut and peanut products produced in the United States, Senegal, and other peanut producing countries of the world. This project is designed to discover improved management procedures for reducing the mycotoxin problems through prevention of contamination, monitoring of peanut in trade channels for diversion of contaminated lots into either clean up or detoxification processes, and the development of improved detoxification procedures. Research activities have been designed to determine when peanut is invaded by the mycotoxin producing fungi in relation to peanut cultivar susceptibility; environmental conditions; and various production, harvest and storage procedures. Experiments have also been designed to develop improved mycotoxin detection procedures, improved inspection and diversion procedures, and methods of removing aflatoxin from crude peanut oil and other peanut products. These research projects will require that the staff utilize the "state of the art" procedures, modern equipment, and dedication to the task. In addition, training of graduate students and technical staff should provide a basis for continued research and education programs for many years in the future.

MAJOR ACCOMPLISHMENTS

Establishment of project

The initial meeting in Senegal to develop a collaborative research project took place in January of 1982, six months previous to the transfer of research funds from AID to the management entity in Georgia. Verbal agreements were made to develop a research program with three governmental agencies in Senegal: Institute Senegalais De Recherches (ISRA), Institute De Technologie Alimentaire (ITA) and Etats De Medecine Veternarire at the University of Dakar. Since the initial meeting we have had excellent support from Dr. Ibranima Thiogane, Le Director General of ISRA in developing a collaborative research program with ISRA, ITA and the Veternarire division of the University of Dakar. Within Texas A&M University a collaborative research program has been developed between the Departments of Plant Pathology and Microbiology, Veterinary Public Health and Electrical Engineering. The Memorandum of Understanding between Texas A&M and Directors of the institutes in Senegal should be completed in late 1983.

Research Results

Peanut samples were obtained from open storage enclosures within Senegal and plated on nutrient media. The predominant mycotoxin fungi isolated consisted of Aspergillus flavus, Aspergillus parasiticus, Penicillium spp., and Fusarium spp. Representative isolates of these fungi have been placed in

pure culture for future study. In addition, several isolates of Macrophomina phaseolina, a fungal species capable of producing metabolites with similar Rf values to that of the Aspergillus flavus group have been placed in pure culture.

Humus containing materials, city sludge and lignite have been tested for their ability to function as a substrate for various saprophytic fungi within peanut soils. Theoretically it may be possible to create an ecological balance of soil microorganisms which restrict the activity of the Aspergilli. A statistical analysis of three way interactions involving; sludge, lignite and N-P-K fertilizer revealed that combinations of sludge, lignite, and N-P-K had less influence on yield compared to a two-way interaction of sludge and lignite, which increased peanut yields.

A simplified procedure for the detection of aflatoxin in raw peanut oil has been discovered. Utilizing some novel sorbants, an improved mini-column was designed that can be used for aflatoxin detection in both extracted and raw peanut oil. The new mini-column procedure produces a sharp band of fluorescence that is both easily read and not subject to bandspreading noted with classical methods.

A simple, inexpensive procedure for removal of aflatoxin from contaminated raw peanut oil, similar to that produced in rural villages of Senegal, has been investigated. Following treatment of the oil with a material that binds aflatoxin, 93-99% of the aflatoxin was removed from test samples.

Electrical measurements of healthy and aflatoxin contaminated peanut kernels have revealed that the dielectric characteristics of contaminated peanut over a frequency range of 10 KHz to 10 MHz is quite different from healthy sound mature kernels. Differences were sufficient to separate the influence of mold and moisture differences in replicate samples.

EXPECTED IMPACT OF PROJECT

In host-country - Reducing the levels of aflatoxin within Senegalese grown peanut will help improve the health of the local population and greatly improve the quality of the peanut meal used in export trade. New methods of electrical or chemical detection of aflatoxin should aid in the diversion of mycotoxin contaminated peanut into processing for clean up and/or detoxification. Development of a marketing procedure which provides an incentive for producing aflatoxin free peanut will help encourage implementation of preventive measures for reducing mold damage. Newly developed aflatoxin sorption methodologies will allow local villagers to treat peanut oil to reduce aflatoxin levels to a safe level for consumption. Future development of peanut varieties with some resistance to penetration by the mycotoxin producing fungi will further reduce contamination once such varieties have been developed and grown in Senegal.

In United States - Research results from efforts on this project will lessen the impact of the aflatoxin problem to the peanut industry in the U.S. Newly developed peanut varieties adapted to the peanut growing regions could greatly reduce the number of Segregation III peanut marketed within the country. Electronic detection of aflatoxin contaminated peanut and improved chemical detection techniques should increase the speed and accuracy of analyses and reduce the cost related to diversions of contaminated peanut lots. Future discoveries related to the diversion and detoxification of aflatoxin in peanut, peanut products and other commodities will lessen the potential health hazard contaminated products currently impose on the American public.

GOAL

The goals of the mycotoxin peanut CRSP research project are to enhance mycotoxin management within the LDC's and the United States through prevention of contamination in foods and feeds; development of improved inspection and diversion procedures, and the discovery of cleanup and detoxification procedures which will render contaminated products safe for consumption.

OBJECTIVES

A. Determine when peanut is invaded by mycotoxin producing fungi and identify the fungi capable of producing mycotoxins.

B. To develop rapid, accurate analytical procedures for detection of mycotoxins in peanut, peanut products, and tissues and biological fluids from animals.

C. To develop interdisciplinary efforts to discover production, harvesting, and curing practices which can minimize mycotoxin contamination of peanut.

D. To develop inspection procedures for rapid detection and diversion of mycotoxin contaminated peanut into processing for cleanup and/or detoxification.

E. To set up training programs within the LDC and in Texas to train staff, producers, inspectors, and processors in detection methodology, fungal identification, and mycotoxin prevention programs.

Approach

Peanut samples will be collected within different regions of Senegal and the fungi present isolated on specialized media. Pure cultures of isolated fungi will be identified and tested for their mycotoxin producing ability. Results from these experiments will be correlated with the environmental conditions, variety, and location from which these fungi originated.

The approach to developing chemical methods of detection and detoxification of mycotoxins in peanut, peanut products and animal fluids will be based on the premise that resulting techniques must be inexpensive, easy to perform, and yet give consistent results in both Senegal and the United States. Developmental procedures will involve a survey of numerous inert agents to determine their ability to bind aflatoxin and other mycotoxins. Selectivity and affinity will be modified via chemical derivatization. Sorbants which show promise will be tested for their ability to detoxify different peanut products.

Various production, harvesting and curing practices within the field will be carefully observed, and when possible, peanut samples recovered from the field to determine possible times when the mycotoxin producing fungi enter the peanut. Attempts will also be made to determine the environmental conditions which favor the invasion of peanut pods by the mycotoxin producing fungi.

Humic materials such as sludge and granulated lignite will be added to peanut field soils in order to determine their influence on the activity of mycotoxin producing fungi.

Peanut pods and seed coats will be tested for their ability to restrict Aspergillus flavus penetration in relation to the structural and biochemical features of these plant parts.

Dielectric measurements of healthy and contaminated peanut will be obtained using a Hewlett Packard LF4192 analyzer and 9845 computer over a frequency range of 10 KHz to 10 MHz. Resultant data will be correlated with the moisture content of all test samples, the extent of mold damage, and the levels of mycotoxins present. Inoculations followed by incubation for contamination of peanut samples will be carried out within an environmental control chamber to provide optimum conditions for the growth of the mycotoxin producing fungi. These conditions will be similar to those observed in field and storage facilities. Test samples will be placed in a specially designed test cell, the size and geometry of which is under study for obtaining maximum sensitivity. All experiments will be conducted using experimental designs which are able to statistically detect possible inter-relationships between various test parameters.

ORGANIZATION

Texas A&M University

Robert E. Pettit, Principal Investigator, Dept. of Plant Pathology, College Station, Plant Pathologist
Ruth Ann Taber, Cooperator, Dept. of Plant Pathology, College Station, Mycologist
James P. Stack, Cooperator, Dept. of Plant Pathology, College Station, Plant Pathologist
Charles L. Martin, Technician, Dept. of Plant Pathology, College Station
Richard W. Jones, Graduate Student, Dept. of Plant Pathology, College Station
Russelyn Henson, Graduate Student, Dept. of Plant Pathology and Microbiology, College Station
Timothy D. Phillips, & Eric C. Shepherd, Cooperators, Dept. of Veterinary Public Health, College Station, Mycotoxicologists
Randall L. Geiger, Electrical Engineer, Dept. of Electrical Engineering, College Station

Senegal

Center National De Recherches Agricoles (CNRA)
Mahavan M'bodj, Le Director
Institut Senegalais De Recherches Agricoles (ISRA)
Ibranima Thiongane, Le Director
Institut De Technologie Alimentaire (ITA)
Ousmane Kane, Le Director

Decision on the specific research staff in Senegal who will work on the Peanut CRSP awaits the decisions of the directors of the collaborative units noted above.

ACCOMPLISHMENTS IN DETAIL

The incidence of Aspergillus flavus and A. parasiticus was determined in kernels and shells from a large pile of commercial peanut stored in the open about 30 km west of Bambey and in kernels and shells of 8 breeding lines stored at the laboratory at Bambey. Samples were surface-sterilized in 70% alcohol and 10% clorox, then rinsed in sterile distilled water before placing on malt salt agar. Malt salt agar was used to selectively inhibit other fungal species and to favor growth of storage Aspergilli. These toxic fungi were isolated from 15% of the kernels and 4% of the shells. Pure cultures of these fungal strains are being established.

Peanut shells from the same locations were examined in the scanning electron microscope. Structural features of these shells will be compared with U.S. cultivars with resistance to soil borne fungi.

In surveying various inert agents, it was found that a specific type of processed earth (PE) bound aflatoxins tightly. When a solution of aflatoxin (1 ug) was pulled through a column containing a layer of this material, aflatoxin B_1, was bound in the top 0.5 mm and could not be washed further into the PE following repeated chloroform washes. This characteristic was utilized in the development of an improved mini-column method of detection.

The column sensitivity for an extracted peanut oil sample spiked with aflatoxins was found to be 5 ppb. This compares favorably with previously reported mini-column detectabilities. When contaminated peanut oil was analyzed directly (without extraction) the sensitivity was diminished to 35 ppb. This was due to the presence of a faint yellow fluorescence that obscures the blue fluorescence of low level aflatoxin samples. The new mini-column produced a sharp, distinct band of fluorescence that is easy to read. In addition the new column was not subject to the band-spreading as seen with other mini-columns and the sample could be pulled through the column without regard to time or speed. The bank of fluorescence was also unaffected by the chloroform washes used to pull the sample through the column.

The tight binding of aflatoxin to PE suggested that this sorbant could be used to remove aflatoxin from contaminated raw peanut oil in a village setting. Two methods of PE/oil contact were investigated. Gravity filtration of the oil through a bed of PE removed greater than 99% of the aflatoxin present in an oil sample yet was impractical due to the slow filtration rate. Mixing the PE with the contaminated oil, allowing it to settle then filtering the top layer of clear oil removed 90-99% of the aflatoxins present depending on the amount of PE added, the incubation temperature and time of contact. There was an increase in aflatoxin binding with temperature. The difference in binding of aflatoxin to PE at room temperature (25-29C) and 100C was 3.5%. When binding of aflatoxin was measured, over time it was found that the rate of binding was quite rapid, reaching 90-93% within the first 30 minutes. After 30 minutes the rate slowed, with the level of aflatoxin binding reaching 99% after 6 hours incubation.

In addition to the projects outlined above we have also completed the preliminary work on a new HPLC procedure for the rapid analysis of aflatoxins in peanut products. This method involves the use of new state of the art HPLC columns coupled with a novel method of extraction.

The experiment designed to determine the influence of sludge, lignite and N-P-K fertilizer on peanut growth have indicated that these materials caused no apparent harmful effect on plant growth. Factorial analysis of peanut pod yields revealed that sludge and NPK had significant main effects on yields. Without sludge applications, pod yields averaged 14.12 gms/pot. With one level of sludge (2,240 kg/ha)(1-SL) pod yields were significantly higher (significant level less than 0.01%), averaging 20.73 gms/pot. Doubling the sludge to 4,480 kg/ha (2-SL) significantly increased the average yield (at the 4.5% level) to 23.20 gm/pot. Plants from pots containing NPK treatments produced yields which averaged 22.38 gms/pot, an increase of 6.05 gms/pot above the yields from pots without NPK. Lignite treatments caused no significant independent effects on pod yields. This research will continue to determine the effect of humic materials on mycotoxin producing microorganisms, especially when used as carriers for biological control mechanisms.

Dielectric measurements of healthy and contaminated peanut were made over the 10 KHz to 10 MHz range. The peanut classified as contaminated initially came from the same lot as the healthy specimens but were inoculated with Aspergillus flavus spores and incubated to induce mold growth and the associated mycotoxin contamination. Measurements were made with a Hewlett Packard LF4192 impendance analyzer controlled by a Hewlett Packard 9845 computer. These tests were made to:

(a) Determine the repeatability of measurements
(b) Determine the size of the test cavity needed for measurements
(c) Relate replication variance to the variance between healthy and contamined specimens
(d) Determine the relationship between the incubation interval and the dielectric characteristics.

Results indicate the repeatability is acceptable. A small cavity which requires lesser quantities of peanut for measurements was seen to give results comparable to those attainable for a larger cavity. The replication variance was quite large but appears to be small enough to distinguish it from the large changes induced by differences in mold or moisture levels. After the initial incubation period, additional incubation showed relatively minor effects on the dielectric characteristics.

PLANS FOR 1983

(a) Peanut samples will be collected in Senegal for microbial analysis
(b) Various peanut varieties and breeding lines currently used in Senegal will be tested for their susceptibility to the mycotoxin producing fungi.
(c) Isolates of A. flavus and A. parasiticus isolated from peanut grown in Senegal will be tested for their ability to produce aflatoxin.
(d) While Texas A&M staff are working in Senegal efforts will be made to train the local staff in the identification of the common fungi found associated with peanut kernels.
(e) The mini-column will be tested for its ability to detect mycotoxins other than aflatoxin.
(f) Efforts will be directed towards the design of a self contained portable mini-column analysis unit that can be carried into the rural village for an on the spot analysis of peanut products.

(g) The newly discovered detoxification procedure will be tested for its ability to remove other mycotoxins from peanut products.
(h) Peanut oil that has been clarified using the newly developed procedure will be tested for its mutagenicity, cell toxicity and carcinogenic potential in order to prove that the posionous nature of the toxin has been truly eliminated by the sorbant treatment.
(i) The sorbants will be tested from their ability to detoxify feed mixtures which have been prepared from contaminated peanut meal.
(j) Efforts will be continued in the development of sophisticated aflatoxin detection procedures using High Pressure Liquid Chromatography with new column materials and faster methods of sample extraction and purification.
(k) Peanut kernels from various breeding lines will be analyzed for the levels of aflatoxin and other mycotoxins present.
(l) Peanut kernels and pods will be examined for their structural and biochemical features and these correlated with varying levels of resistance to mycotoxin producing fungi.
(m) A search will be made for peanut pods with resistance to mycotoxin producing fungi.
(n) Various types of humus will be added to potting mixtures in greenhouse experiments to determine the influence of these additives on the activity of A. flavus and A. parasiticus within the mixture.
(o) Peanut pods will be inoculated with various mycotoxin producing fungi under controlled environmental conditions in order to determine the optimum conditions for invasion of different pod types and varying degrees of pod damage.
(p) Peanut kernels from different cultivars will be inoculated with different mycotoxin producing fungi, incubated in controlled environmental conditions and their dielectric properties determined.
(q) The degree of mold damage, effects of incubation time, temperature, and relative humidity will be correlated with the dielectric properties of given peanut kernel samples and the levels of mycotoxins present.
(r) An experiment will be conducted to determine the dielectric properties of mold damaged peanut and their relationship to moisture content of the kernels and the degree of mold and mycotoxin damage.

"PEANUT VIRUSES: ETIOLOGY, EPIDEMIOLOGY, AND NATURE OF RESISTANCE"

University of Georgia - Institute for Agricultural Research
at Ahmadu Bello University, Nigeria

James W. Demski, Principal Investigator, UGA

INTRODUCTION

Groundnut (peanut) rosette is a major constraint in the production of peanut in Africa and along with other viruses cause significant yield losses. Groundnut rosette has been known since 1907, but the etiologic agent(s) has not been clearly defined. Before control measures can be implemented the etiologic agents must be defined, a rapid method of identifcation developed, the source of virus found and the nature of resistance elucidated.

Currently a new virus infecting peanut in the U.S. is being identified and characterized. Preliminary data indicates this new virus, if established in peanut in the U.S. and other areas of the world, has the potential to become a damaging virus of peanut because of its high frequency of seed transmission, rapid dissemination in the field where the crop often takes over four months for maturity, and the yield loss it induces.

MAJOR ACCOMPLISHMENTS

Establishment of project

This project was established when Dave Cummins and James Demski went to the Institute of Agricultural Research (Nigeria) in February 1982 to discuss goals, research objectives, and collaborative work with Director John Davies, Dr. Colin Harkness and Dr. Steve Misari. Mutual interests were confirmed and a Memorandum of Understanding and Plan of Work was signed.

Working trips were made to Nigeria during the 1982 peanut growing season by James Demski (July 17, 1982 to Aug. 20, 1982), James Chalkley (James Demski's technician) (Aug. 14, 1982 to September 3, 1982), and Cedric Kuhn (Aug. 28, 1982 to Sept. 24, 1982). The last two days of each persons trip was spent in Germany where samples were assayed in a modern virus laboratory.

Research results

In Africa aphid transmission of green and chlorotic rosette can be done routinely with near 100 percent efficiency. Mechanical transmission of green and chlorotic rosette has been accomplished, but the efficiency of this technique needs to be raised above the current 50 to 60 percent range. Peanut plants having rosette symptoms after aphid inoculation were taken from Nigeria to Germany (by D.V.R. Reddy of ICRISAT and later by Univ. of Georgia personnel) where positive serological tests were obtained against beet western yellows virus (a luteo virus) antiserum (a manuscript on this aspect has been accepted by Phytopathologische Zeitschrift). No serological reaction with beet western yellows antiserum is obtained from peanut plants that have been mechanically infected suggesting an involvement of two causal components.

Electron microscopy confirms this; 28 nm spherical particles have been observed from tissue infected by aphids, but no particles have so far been observed from mechanically infected tissue. It is possible that the symptom inducing agent is a defective virus (free nucleic acid) and thus virus particles cannot be detected by these tests; however the symptom inducing agent when in combination with the luteo virus may be encapsidated with the protein sub units of the luteo virus and thus be transmitted by aphids.

At least 4 or 5 viruses have been isolated by mechanical transmission from plants collected from the field. These include chlorotic rosette, green rosette, tomato spotted wilt virus (TSWV), cowpea mild mottle and some unknowns. No positive response was observed with cucumber mosaic virus or peanut mottle virus in serological tests.

The source of the primary infected rosetted plants in the field is not known, but subsequent spread that leads to the epidemics appear to disseminate outward from these primary sources. Thus pockets or patches of rosetted plants commonly occur and are either chlorotic or green rosetted. This seemed to indicate that, on arrival, viruliferous alate aphids could inoculate several plants or that the spread in the field could be by the subsequent aphid generations of the initial coloniser. This has significant implications for timeliness for aphid control immediately on arrival.

In the U.S. a new virus naturally infecting peanut has been isolated. This virus appears to be related to several potyviruses, but not related to peanut mottle virus which is endemic in peanut in many parts of the world. The new virus causes a yield loss of at least 20 percent (based on one test in the greenhouse) and is seed transmitted at about 30 percent. This virus has been associated with seed that has been received from China, but field spread in the U.S. has resulted in common U.S. cultivars becoming infected and in turn is transmitted through their seed. Twelve of the U.S. cultivars most commonly grown are fully susceptible to the new virus. Because of the high seed transmission rate, susceptibility of U.S. peanut lines, availability of aphids (vectors) in the U.S. peanut production areas, and the long maturity time for peanut (135 days), this virus has great potential to adversely affect peanut production. Therefore, continued studies and actions are being taken to control this virus. In addition, peanut mottle virus occurs in all the peanut producing areas of the U.S. and the possibility exists that the two viruses could cause severe yield losses.

EXPECTED IMPACT OF PROJECT

In host-country. Because of the epidemic of rosette in Nigeria in 1975, many growers have reduced or eliminated peanut production in their farming operations. After initial research efforts have defined the basic epidemiological aspects, and the causal agents can be readily identified and manipulated, then this will open the way for numerous research opportunities. Breeding programs and ecological studies can be instituted, control strategies can then be made available for use by peanut breeders. The biological nature of resistance will be established. Studies on epidemiology will provide a variety of approaches which can be used in control. All approaches may be used in an integrated control program or specific approaches may be adapted to disease and environmental conditions in a given geographical area. Control of rosette disease should permit growers to produce peanut profitably and thus reverse the declining production trends and raise the per capita production.

In U.S. The CRSP virus project has lead to the discovery of a new virus infecting peanut in the United States. This virus has the potential to be a damaging virus in U.S. peanut production if not controlled. Programs are underway to eliminate this seed borne virus before it becomes endemic in other hosts that could serve as new sources of inoculum.

The University of Georgia will maintain an antisera bank and a seed bank of virus free seed. It will be possible to achieve rapid diagnosis of the peanut virus diseases in any part of the world without sophisticated facilities by serological tests and host reactions. These tools will be available on a world basis. If written instructions for diagnosis are inadequate, a short course will be developed for presentation wherever needed.

GOAL

Virus diseases, in epidemic proportion, are limiting factors in peanut production. The three most destructive viruses infecting peanut, on a worldwide basis, are peanut mottle (PMV), groundnut rosette (GR), and bud necrosis (BN). BN is especially damaging in India where major research efforts at ICRISAT are directed towards the problem. PMV is worldwide in distribution but except for identification and yield loss documentation, little research has been done outside the USA. GR although restricted to Africa, is extremely important because of the serious losses it induces and the large quantity of peanut produced in the African countries. We propose in-depth research on GR, some epidemiological and resistance studies on PMV, and the identification of other viruses of peanut that occur in Africa and the U.S. Therefore, the major goal of this project is through research efforts to attain a better understanding of the causal agent of GR and the disease so that some methods of control can be developed for GR and other viruses.

OBJECTIVES

A. Determine the etiology of groundnut (peanut) rosette.

B. Determine the epidemiological factors of groundnut rosette.

C. Select and determine the nature of resistance in groundnut to groundnut rosette.

D. Identify other peanut viruses, determine the variants of these agents, and develop means of rapid identification.

Approach

In May 1983, a planning conference was held at the Georgia Experiment Station for the purpose of determining the approach to the various facets of the research problem. The various cooperators have special skills that should help bring the project to a successful conclusion.

Dr. Steve Misari in Nigeria is a specialist in insect vectors and will develop those facets of the program related to aphid transmission. He also works closely with Dr. Demski on the epidemiology phases.

Dr. Okon Ansa has a background in molecular biology and serology. He will work on virus purification, nucleic acid extraction, and serology to the extent that can be completed in Nigeria, but may also go to European labs.

Dr. D.V.R. Reddy has worked extensively with ELISA serology and has many antisera to different peanut viruses which are available to all workers. He will also work on the chemical characterization of rosette components. Dr. Reddy will spend 8 months of a years sabbatical in Dr. Demski's lab.

Dr. Rudolf Casper has an excellent facility including the use of an electron microscope. Components that have been separated in Nigeria are being taken to his lab for various assays including serology and nucleic extraction. In addition, a graduate student (Sylke Meyer) may go to Nigeria to do serological tests for different peanut viruses.

Dr. Cedric Kuhn has extensive experience with virus manipulation (transmission, separation, isolation), nucleic acid extraction, serological testing and studying the nature of resistance. He will work both in Germany and Nigeria on these facets.

Dr. James Demski will work on the epidemiology aspects, separation of components in Nigeria and in general coordinate the project.

ORGANIZATION

University of Georgia

Dr. James W. Demski, Principal Investigator, Dept. of Plant Pathology, Georgia Experiment Station, Virologist
Dr. Cedric Kuhn, Cooperator, Dept. of Plant Pathology, Athens, Virologist

Istitute for Agricultural Research (IAR)

Dr. Steve Misari, Dept. of Crop Protection, Ahamadu Bello University, Samaru-Zaria, Nigeria, Vector entomologist
Dr. Okon Ansa, Virologist

Informal cooperation exists with ICRISAT with D.V.R. Reddy cooperating. Dr. Reddy's address is: Dr. D.V.R. Reddy, Principal Virologist, International Crops Research Institute for Semi-Arid Tropics, Patancheru P.O., Andhra Pradesh 502324, India.

Informal cooperation also exists with the Virus Institute in W. Germany with Dr. Rudolf Casper cooperating. Dr. Casper's address is: Dr. Rudolf Casper, Biologische Bundesanstalt Fur Land-und Forstwirtschaft, Institute Fur Viruskrankheiten der Pflanzer, Messeweg 11/12, 3300 Braunschweig, West Germany.

Because the U.S. and India have peanut production, but do not have groundnut rosette, those phases of the work that are difficult to complete in Africa are done in Germany. Germany does not have peanut production so fresh tissue can be studied in the laboratory having modern facilities.

Also, for a four month period (Nov. 1983 through Feb. 1984) Dr. Reddy will work on the chemical characterization of the mechanical transmissible component of groundnut rosette and its relationship to the aphid transmissible component in Dr. Tony Murants laboratory in Dundee, Scotland. Dr. Ansa from Nigeria will take tissue to Scotland from Nigeria (that Dr. Demski and Kuhn inoculated) and spend two weeks working on nucleic acid extraction techniques. This would enable Dr. Ansa to do extensive studies in Nigeria on the etiology of groundnut rosette.

ACCOMPLISHMENTS IN DETAIL

Aphid transmission can be accomplished by maintaining a culture of Aphis craccivora on healthy peanut, transferring one aphid to a rosetted plant for two days and then transferring the aphid to the recipient plant for one day. Nearly 100 percent efficiency has been achieved.

Mechanical transmission is successful, but 100 percent efficiency has not been obtained. Generally only 50 to 60% of the plants become infected. However, it is the first time consistant mechanical transmission of rosette has been accomplished. By comparing different buffers, reducing agents, methods of inoculation, different abrasives, etc., the best method is; when magnesium bentonite and mercaptoethanol are in the inoculum buffer (0.1 M PO_4, pH 7.2), keeping the plants to be inoculated in the dark for 12 hours before inoculation, inoculating plants soon after emergence (1st true leaf stage), and using previously mechanically inoculated plants as the source of inoculum.

Serological tests have given positive reactions with beet western yellows antiserum (a luteo virus antiserum) from plants inoculated with aphids, but not from plants that have been mechanically infected. This indicates that at least two components may be present, but only the mechanical transmissible agent is necessary to induce typical symptoms. Therefore, to achieve separation of components, mechanical transmission has been used to separate the symptom inducing component. To separate the luteo component we have permitted viruliferous aphids to feed on healthy peanut for very short periods of time, hoping that the luteo component will be transmitted to a few test plants without the symptom inducing component. Preliminary serological tests gave weak positives that indicate this method may prove successful. Once the components are separated, they can be individually characterized and then recombined to induce the typical disease.

Natural field occurrence of groundnut rosette has been monitored by surveying growers plantings of peanut and marking (stakes) infected plants. Weekly inspection and recording of new infections as the season progresses reveals that a few primary infections occur early in the season but most new infections occur next to the primary infected plants indicating a local dissemination. This results in many infected plants only in certain areas of the plantings and indicates that secondary spread is what leads to the development of epidemics.

Aphid populations irrespective of sowing date (mid-June or beginning July) attained a peak between the end of July and the first week of August. Aphids colonise the crops early at germination before their populations built up to a peak. Application of insecticides generally depressed and delayed aphid population build-up. Furadan 3G and Croneton 500E.C. significantly (P. 0.001) lowered the aphid populations more than Pirimor E.D. Marshall ST or Mocab 10G which definitely proved inferior to the former. In all the experimental fields, Furadan 3G applied at the rate of 1 kg a.i./ha at planting gave the best control. Excellent control was achieved up to four weeks after planting. Fewer rosetted plants and higher pod yields were recorded on plots treated with Furadan 3G and Croneton EC and 20cm spacing than on plots treated with Mocab 10G. Marshal ST, or Pirimor and/or wider spacing (30 or 40 cm) with any of the treatments.

Six varieties MK374, Samaru 38, Ex-Dakar, Spanish 205, M25. or 68 and 69-101 were tested for differential resistance to rosette and the vector in the field. Both green and chlorotic rosette strains were observed with varying degrees of incidence on all the varieties. Aphid population levels were generally similar in the pairs of "phenologically" related (MK374/Samaru 38, Ex-Dakar/Spanish 205; M25.68/69-101) groundnut cultivars. Although the varieties 69-101 and M25.68 proved to be rosette resistant, all the six varieties tested were similarly heavily attacked by the aphid vectors. This indicated that the resistance mechanism is likely to be inherent in the resistant varieties and that it may be antiviral in nature.

Twenty years or more in the past only green rosette was observed in Nigeria (and West Africa). Currently chlorotic rosette is common and may be the dominant type of rosette.

In the U.S. during the late summer of 1982, Dr. Grover Sowell (USDA Pathologist) observed some plant introductions at the Georgia Experiment Station that were showing a virus symptom that was not typical of peanut mottle virus (the endemic virus). This virus was isolated to plants in the greenhouse. Host range studies and serological tests indicated this virus was indeed a new virus and not related to other peanut viruses known to infect peanut in the U.S. All subsequent tests were carried out in the greenhouse or laboratory under protected conditions. Argentine and Florunner seeds were planted in 30 cm pots in the greenhouse for a yield loss study. Plants in each pot were thinned to two plants per pot. The plants in 10 pots were inoculated with the "new" virus in the third true leaf stage and individually alternately placed on a greenhouse bench with 10 pots containing healthy peanuts. Seed of Argentine, Florunner, and PI 461434 were planted in 30 cm pots in a greenhouse test for seed transmission. Plants were thinned to two per pot. Plants in the 10 pots of each variety were inoculated in the third true leaf stage and the plants maintained to maturity. Pods were harvested at maturity, dried, hand shelled, and stored for two months. The seed were then planted in flats in the greenhouse and permitted to germinate. When the seedlings were in the sixth true leaf stage, individual seedlings were assayed by ELISA. In other tests the virus was propogated in Lupinus alba, purified, and a specific antisera produced. During the growing season of 1983, surveys of peanut plantings in Georgia, North Carolina, Virginia, and Texas showed that this new virus was naturally infecting peanut in all states. By tracking the origin of the seed used in each of these areas, it was found that the seed either came from China or from parents that were growing near China material previously (at least in all cases that are traceable). The results of the yield loss study indicated a 20 percent loss, and the seed transmission test showed a near 30 percent seed transmission rate. Laboratory studies clearly indicated aphids could readily transmit this new virus and field observations indicates rapid natural spread. All of these factors show that this virus has the potential to cause great damage to the U.S. peanut production. Therefore, current actions are underway to stop the spread of this virus.

PLANS FOR 1983

To increase the efficiency of mechanical transmission.
Ansa, Misari, Kuhn, and Demski in Nigeria.
Casper in Germany.

Work on separating the luteo component of rosette.
    Misari, Demski, Kuhn in Nigeria.
    Casper in Germany.

Characterization of the symptom inducing agent.
    Reddy in Scotland.
    Kuhn in Germany.
    Ansa and Kuhn in Nigeria.

If successful in separating the luteo component - then purification of this component for specific antisera.
    Reddy in Scotland.
    Ansa in Nigeria.
    Casper in Germany.

Start work on the nature of resistance to rosette.
    Kuhn, Misari in Nigeria.

Finish aphid transmission studies.
    Misari in Nigeria.

Serological tests.
    Casper in Germany
    Meyer, Ansa, Kuhn, Demski in Nigeria.

Clarifying epidemiological aspects.
    Demski, Misari in Nigeria.

"An Interdisciplinary Approach to Optimum Food Utility of Peanut in SAT Africa"

Alabama A&M University - Democratic Republic of the Sudan

Bharat Singh, Principal Investigator, AAMU

INTRODUCTION

The project aims to initiate a collaborative interdisplinary research and development program on peanut utilization for human consumption between Alabama A&M University and the Agricultural Research Corporation in the Sudan. Peanut is an important cash crop in the Sudan. It provides 7 percent of the GNP and employs 12 percent of the population. Sudan is the fourth leading country in peanut production after India, China, and the United States. In the Sudan, peanut is used primarily as an oilseed crop and approximately 60% of the peanut is converted to peanut oil. The meal is generally not utilized for human consumption. Most of the peanut meal is exported rather than used within the country. Yet, a recent study from the University of Khartoum indicates that a large segment of Sudanse population (including infants and small children) subsist on an inadequate diet. It has been known that aflatoxin-free peanut and peanut products can easily be incorporated into daily diets for improvement of protein and calories in underdeveloped countries. Peanut utilization in common dishes of Sudan have been limited by various constraints. Understanding of the environmental and socioeconomic constraints, as well as those of food preservation and preparation technology are needed if sufficient cost-effective, tasty, nutritious and aflatoxin-free peanut is to be made available. In addition to production technology, cultural practices impacting the supply of peanut include storage techniques and inventory management system.

Project objectives have been discussed with collaborators from the Agricultural Research Corporation in the Sudan. Sudanese scientists are fully participating in coordination, implementation, and evaluation of the research. Implied in the collaborative study is the realization that to Sudanese populations, the change most desired in food consumption is a reliable and adequate supply of the traditional diet. This emphasis should effect development of research capabilities sensitive to research needs of the region, specifically, research on optimizing food utility of the peanut. The first phase of the study includes a consumption survey to assess at different income levels and in contrasting markets the current and potential dietary role of existing peanut products. Further, a survey is planned to assess postharvest practices that impact the supply of peanut, including storage techniques and inventory management techniques.

MAJOR ACCOMPLISHMENTS

Establishment of Project

A considerably long interval elapsed from the time of approval of the project (February, 1982) by the Peanut CRSP Management Office and formal completion of the project documents in June, 1983. The project has been reviewed and approved by the Directorate of Agriculture and the Ministry of Agriculture.

Research Results

Survey: Two survey instruments have been developed, one dealing with consumption and food utility aspects of peanut and the other dealing with post-harvest technology of peanut. The instrument dealing with consumption survey has been pretested in the Khartoum area and has been found to be satisfactory. We have agreed to conduct the survey at four different sites: Khartoum (Capital City and adjoining Omdurman and North Khartoum area), El Obed (Khordofan Province in Western Sudan) and Wad Medani (Blue Nile Province). The data will be collected from two urban populations (Khartoum, El Obeid) and two rural populations (El Obeid area and Wad Medani area). Arrangements have been made to initiate these surveys during post-harvest period in the fall and continue during the spring.

Aflatoxin Laboratory: Arrangements have been made to establish an aflatoxin laboratory at the Food Research Centre to monitor aflatoxins in peanut. Equipments and supplies for the laboratory will be acquired through the Peanut CRSP Project and supplied to the FRC during the Fall, 1983.

EXPECTED IMPACT OF PROJECT

Impact of Project in Sudan

(1) The project has established a linkage between Alabama A&M University and the Sudanese scientists at the Agricultural Research Corporation and Food Research Centre. Eventually, this will lead to long-term collaborative studies, research and development of peanut-based food products.

(2) The data from the proposed survey will define conditions of storage, preservation and utilization of peanut to promote improved nutrition in rural populations.

(3) Improved and innovative means of storage, preservation and preparation for consumption of peanut may be introduced. The proposed survey will lead to the identification of existing efficient and more appealing products and procedures.

(4) The most vulnerable Sudanese populations (rural/urban) may have increased and prolonged opportunities to benefit from peanut consumption.

(5) To impact favorably the status of women, techniques will be designed to utilize and reward women's indigenous means of production. The project aims to identify improved and innovative peanut processing technologies to allow increased efficiency of women in family food preparation and/or alternative income generating activities, e.g., peanut-based foods as a cottage industry product for sale.

(6) Experience gained in Sudan can be used in developing projects in other countries with similar peanut consumption patterns.

(7) More specifically, the project will enhance the capability of the Agricultural Research Corporation to analyze peanut, peanut products and other food products for aflatoxin and other contaminants and to analyze the socio-economic impact of peanut utilization.

Impact of Project in U.S.

(1) The project has provided an opportunity to Alabama A&M University to develop capability in solving world problems and to further strengthen programs in international food and agriculture.

(2) Since the establishment of the project, the School of Agriculture at Alabama A&M University has started a project on evaluation of toxic components of peanut flour and meal including protease inhibitors, phytic acid and aflatoxins. It certainly will enhance the program on utilization of peanut.

(3) Also since initiation of the project, an Alabama A&M farming systems project for North Alabama has been proposed and is expected to be funded by O.I.C.D. It will benefit from the experience with the post-harvest survey and on farm research in Sudan.

(4) The result on breeding and selection of aflatoxin resistent varieties of peanut in the Sudan and other Peanut CRSP host countries will be of significance to the farmers of Alabama and other peanut growing states.

(5) The State of Alabama will further derive benefits through the transfer of technologies of peanut processing and utilization to the Sudan.

GOALS

General Goal

To foster interdisplinary (nutrition, food science, social and economic) institutional-based linkages between U.S. and LDC scientists serving major peanut producing and consuming populations of the Sahel region of Africa for the purpose of optimizing the food utility of the peanut.

Specific Goals

Specific goals of the project are consistent with the general goal of the Peanut CRSP to develop collaborative research and development programs on the peanut between social scientists and food scientists at Alabama A&M University and the Agricultural Research Corporation of the Sudan.

OBJECTIVES

A. Description and understanding of variations in environment, socioeconomics, and food technologies as they constrain the preservation and utilization of peanut supplies.

B. Analysis of the current and potential dietary role of existing peanut products.

C. Research on the improvement of existing peanut products and the development of new products with suitable energy density, nutrient concentrations and preferred tastes at acceptable cost.

D. Ensurance of safety of the products with particular reference to mycotoxins in raw and finished products, and

E. Exchange of peanut germplasm for breeding resistent varieties to aflatoxin.

ORGANIZATION

Alabama A&M University

Dr. Bharat Singh, Principal Investigator, Department of Food Science, Normal, Food Scientist
Dr. John C. Anderson, Cooperator, Department of Food Science, Normal, Food Scientist
Dr. Virginia Caples, Cooperator, Division of Home Economics, Normal, Home Economist
Dr. H. Jones, Cooperator, Department of Agribusiness, Normal, Rural Economist
Dr. R. Rao, Cooperator, Normal, Nutritionist
Dr. G.C. Wheelock, Cooperator, Department of Agribusiness, Normal, Rural Sociologist.

Sudan

Agricultural Research Corporation and Food Research Centre
Dr. H.M. Ishag, National Coordinator, Groundnut Research
Dr. B. Bashir, Deputy Principal Investigator, Food Research Centre
Dr. A.B. Ahmadi, Plant Breeder
Dr. S.M. Badi, Cereal Chemist
Dr. A.S. Khalid, Microbiologist
Dr. B.I. Magboul, Nutritionist
Dr. A.G. Tayeb, Chemist
Mr. A.B. Zakaria, Rural Economist

Relationship with International Agencies

The A&M team members have discussed the project objectives with members of the Nutrition Division of the FAO. There is a possibility of collaboration in aflatoxin area in the Sudan. Similar relationships will be developed with Tropical Products Institute in London and ICRISAT and CFTRI, India in the future.

Approach

Linkage - The linkage with the Agricultural Research Corporation and Food Research Centre of the Sudan and Alabama A&M University and the Management Entity of the Peanut CRSP has been formalized through a Memorandum of Understanding. The Plan of work has been further discussed and agreed upon between scientists from the collaborating organizations.

Survey Documents - Two survey documents have been developed. The consumption survey instrument includes among other things: (a) amounts and types of peanut foods consumed daily, weekly, monthly, seasonally; (b) intra-family consumption patterns; (c) impact of the role of women on peanut intake; (d) cost and preference constraints; (e) source of peanut for family; (f) types of fats (oils) consumed; (g) amount of peanut oil consumed; and (h) food preparation methods.

The postharvest survey instrument will include questions to identify efficient methods, or to diagnose needed modification or development of a new system. Initial quality evaluation will be made on degree of maturity; mold contamination; aflatoxin levels; residue of insects and insect fragments; amounts of protein, fat, and carbohydrates; and, data on temperature, humidity and method of packaging. Samples will be taken to assess the losses during handling and storage.

Research plans on improvement of the products or production of new acceptable foods will be developed after the analysis of the survey data.

Survey Sites, Sample Size, and Survey Plan - The following sampling populations are proposed: Khartoum (an urban population; Wad Medani (A rural population; El Obeid (urban and rural population). A minimum of 100 households will be included in each population during the survey. Sample forms will be developed and stratified by income levels.

The survey will be done twice for each community. One survey will be done during postharvest period (Fall 1983) at which time there is an abundant peanut supply and the other survey will be done during the Spring of 1984.

Analytical Procedures - Samples will be analyzed using standard AOAC methods for protein, fat, moisture, fiber and carbohydrates at the Food Research Centre. Aflatoxin levels will be determined using fluorotoxinmeter. They will be compared using standard procedures.

Organization of Laboratory - Equipments and supplies for establishing the aflatoxin laboratory at the Food Research Centre will be purchased through the Peanut CRSP Project.

ACCOMPLISHMENTS IN DETAIL

Sixteen months elapsed from the time of approval of the project (February, 1982) by the Peanut CRSP Management Office and formal completion of the project documents in June, 1983. This delay, however, has provided the ARC, Sudan, an opportunity to review the whole peanut program and to determine relevance of the Peanut CRSP Project. Apparently, the administration of the ARC has determined that the completion of the objectives of the Peanut CRSP in the Sudan will be of significance to the total peanut program. A major addition to the proposed objectives has been made to include an objective

related to the development of capabilities to monitor peanut and peanut products for aflatoxin contamination.

To finalize details of the project and initiation of the survey during the postharvest period in 1983 (November-December), Drs. B. Singh, V. Caples, H. Jones and G.C. Wheelock visited Sudan from May 26 - June 17, 1983. We discussed in detail the plan of work including survey instruments, implementation strategies, sites of the survey, and establishment of an aflatoxin laboratory.

Survey Instrument

Two survey instruments have been developed (available from Principal Investigator). The survey instruments dealing with consumption and food utility aspects of peanut were reviewed with Dr. B.I. Magboul (Nutritionist) and Dr. B. Bashir (Food Scientist) at the Food Research Centre. Dr. Kamal Ahmed Mohd, Director, Nutrition Division, Ministry of Health, has agreed to cooperate on the survey. A pretest on the consumption survey instrument was made in the Khartoum area with an assistant from the Ministry of Health. Apparently, there was no major problem in the pretest. One problem recognized was the method of estimation of the quantity of peanut. It appeared that (a) the survey instrument was adequate, (b) the interviewer from the Ministry of Health was well trained and had no problems, and finally (c) the family members were willing to provide information and seemed to be very friendly. Based on limited informations, peanut are used in a variety of forms in the Sudan and also the lower income families use more peanut compared to higher income groups.

The survey instrument dealing with postharvest technology of peanut was discussed in detail with Mr. Zakaria, Dr. Bashir, Dr. Magboul and Dr. Khalid. Further, it has been discussed with Dr. Brian D'Silva who is currently working as a visiting professor at the University of Khartoum. The instruments appeared to be adequate.

Survey Sites

We have agreed to conduct the survey at four different sites: Khartoum (capital city and adjoining Omdurman and North Khartoum area), El Obeid (Khordofan Province in Western Sudan) and Wad Medani (Blue Nile Province). In El Obeid area, we will conduct surveys in both rural and urban populations; in Khartoum only urban populations and in Wad Medani area only rural populations. Arrangements have been made to initiate these surveys during postharvest period in the Fall and continue during the Spring.

Survey Data

It has been proposed that the data collected will be analyzed initially in the Sudan. Further analysis and intrepretations will be made at Alabama A&M University. A mini-computer will be bought through the project and will be available to scientists at the Food Research Centre.

Aflatoxin Laboratory

Equipment and supplies for the aflatoxin laboratory have already been ordered and will be sent to the FRC by November, 1983. Dr. Amna Khalid has made a plan to sample, store and analyze peanut samples in her laboratory.

The quality of analysis will be maintained by check sample program with American Oil Chemists Society and with Tropical Products Institute in London.

Nutrient Analyses

Analyses of samples for protein, fat, fiber, carbohydrates and moisture will be made at the Food Research Centre. Although the capability to analyze these data exists at the Food Research Centre, more equipment and supplies are needed to handle the number of samples collected during the survey period and also during the research phase dealing with improvement of existing products and development of new products.

PLANS FOR 1983

1. Implementation of survey
2. Analysis and interpretation of survey data
3. Analysis of peanut and peanut products for aflatoxin contamination
4. Variations in major nutrients in peanut grown at various locations in the Sudan
5. Initiation of research on improvement of storage and handling of peanut during postharvest periods
6. Initiation of research on improvement of existing food products
7. Initiation of research on development of new food products.

"Peanut Varietal Improvement for Thailand and the Philippines"

North Carolina State University - Thailand and Philippines

Johnny C. Wynne, Principal Investigator, NCSU

INTRODUCTION

Peanut yields in Thailand and the Philippines are less than one-half of those in the U.S.A. Major constraints to increased production are inadequate moisture, low soil fertility, diseases, insects, and lack of proper management. The development of improved varieties resistant to diseases and insects and tolerant to the constraints of the environment suitable for the cropping systems of Thailand and the Philippines could lead to increased productivity

Philippines - The peanut breeding program, including the development of pest-resistant cultivars, is part of the Institute of Plant Breeding (IPB) which is organized under the aegis of the College of Agriculture of the University of the Philippines at Los Banos (UPLB) through a semi-autonomous arrangement. Plans and programs of IPB are reviewed annually by an advisory board composed of the Minister of Agriculture, the Dean of the College of Agriculture, the Director of Research of UPLB, the Director of the Crops Research Division of the Philippine Council for Agriculture and Resources Research (PCARR) and a representative of the private sector. IPB is headed by a director and is composed of crop research groups, support laboratories and service units. Each crop research group consists of plant breeders, plant pathologists, entomologists, agronomists, geneticists and plant physiologists. The peanut program is part of the legume crop research group.

A portion of the peanut breeding research is funded through a grant from the International Development Research Centre (I.D.R.C.) of Canada. The goal of the I.D.R.C. program is to provide peanut cultivars for the Asian Cropping Systems Network which is a cropping-systems testing program for rain-fed rice cropping systems in 11 southeastern Asian countries. The program is conducted by the International Rice Research Institute (IRRI) under the direction of Dr. Virgilio Carangal.

Thailand - Peanut research has primarily been conducted in Thailand by the Department of Agriculture and two agricultural universities: Khon Kaen and Kasetsart. A coordinated program administered by the Department of Agriculture but also involving the two universities was organized in 1981. Both the Canadian I.D.R.C. and the Peanut CRSP are supporting the coordinated program. I.D.R.C. primarily supports Khon Kaen and Kasetsart universities while the CRSP primarily supports the Department of Agriculture. Breeding research is concentrated on developing cultivars with higher yield and disease resistance. Emphasis is being placed on developing cultivars suitable for a rice cropping system under rain-fed conditions. In addition to assisting in screening germplasm for disease resistance, the plant pathologists are monitoring peanut diseases in order to develop control practices. Agronomic studies including plant populations and spacings have already been conducted for the main growing season. Additonal studies are needed for the rice cropping system which will differ from the main growing season because of limited moisture. Land preparation practices to conserve moisture, ensure good crop establishment and reduce weed populations are being evaluated.

Division of responsibilities among the three institutions is given in Table 1. While the Department of Agriculture has responsibility over all ecological zones, emphasis is on the Northeast. Khon Kaen University will also concentrate on the Northeast while Kasetsart University will concentrate on the Central Plain.

MAJOR ACCOMPLISHMENTS

Establishment of projects

Plans of work for the establishment of projects in both Thailand and the Philippines for the period July 1, 1982-June 30, 1983 were approved in early February 1983. The plan of work for the Philippines implemented the project under a Memorandum of Understanding establishing a collaborative research relationship on peanut which is coordinated by the Philippine Council for Agriculture and Resources Research and Development (PCARRD). The plan of work for Thailand implemented the project under a Memorandum of Understanding establishing a collaborative research relationship on peanut which is coordinated by the Department of Agriculture.

Research Results

Thailand - Yield trials of peanut germplasm selected for high yields, drought tolerance, salinity tolerance, rust resistance and leafspot resistance were conducted to identify lines for advanced testing. More than 2000 additional peanut lines were introduced into Thailand for preliminary evaluation. Several cropping systems involving peanut were tested and found to have potential use in northeast Thailand by researchers at Khon Kaen. Disease monitoring studies were initiated in the Northeast. Three Thai PhD candidates from the Department of Agriculture were identified and interviewed for an assistantship at North Carolina State University.

Philippines - Approximately 50 accessions with known resistance to diseases or insects were introduced into the Institute of Plant Breeding program. The germplasm was evaluated for disease resistance. Promising entries will be entered into the Filipino peanut testing program.

North Carolina - Approximately 200 breeding lines were increased for distribution to Thailand and the Philippines during 1983. Crosses involving rust-resistant, leafspot-resistant, aflatoxin-tolerant, drought-tolerant and early maturing peanut lines and lines adapted to Thailand were completed. A group of interspecific hybrids was made in a project to introgress germplasm from wild to cultivated peanut. Hybrid lines from previous hybridizations were found to be resistant to early leafspot. The role of individual resistance factors affecting infection rate-reducing leafspot resistance was investigated in selected peanut breeding lines. Studies to evaluate peanut germplasm for late leafspot and aflatoxin resistance were initiated.

Table 1. Scope of work for three institutions in Thailand

Research concern	Department of Agriculture	Khon Kaen University	Kasetsart University
Breeding			
A. Specific characters			
1) High yield potential	**	**	**
2) Earliness	**	**	*
3) Rust resistance	**	**	
4) Cercospora leafspot resistance	**	**	
5) *Aspergillus flavus* resistance	*		**
6) Salinity tolerance	*		
B. Growing environment			
1) Main rainy season	**	*	**
2) Dry season with irrigation	**		**
3) Before rice (rainfed)	*	**	
4) After rice (rainfed)	**	**	
C. Variety evaluation			
1) Initial yield trial	X^R	X^R	X^R
2) Preliminary yield trial	X^R	X	X
3) Standard yield trial	X^R	X	X
4) Regional yield trial	X^R	X	X
5) Farmers' field trial	X^R		
6) Farm test	X		
Pathology			
1) Rust resistance	**L	**F	
2) Cercospora leafspots	**L	**F	
3) Race identification of rust	*		
4) Seed treatments	*		
5) Disease monitoring	*	*	
6) Epidemiology	*	*	
7) Viruses	*	*	
8) Aflatoxin resistance	*		**
Agronomy			
1) Plant population & spacing	*		
2) Land preparation & cultivation	*		
3) Chemical weed control	*		
4) Methods of planting & irrigation	*		
5) Lime & fertilizer responses	*		
6) Crop residue management	*		
7) Minor nutrients	*		**

** = major emphasis, * = less emphasis, X = participating institution, R = responsible institution, L = laboratory, F = field.

EXPECTED IMPACT OF PROJECT

Thailand and Philippines - The yield of peanut in Thailand and the Philippines is about one-half of that in the U.S.A. Many of the factors which limit the yield of peanut can be overcome by the development and proper management of improved varieties. The CRSP project should provide the peanut improvement projects of Thailand and the Philippines training, technical assistance and additional germplasm. This should lead to the establishment of breeding projects that will develop improved peanut varieties adapted to the local environment. The release of improved varieties in conjunction with appropriate management practices should allow small growers to increase yields with little or no additional production inputs. The increased production should increase the food and vegetable oil supply in Thailand and the Philippines helping to alleviate shortages.

U.S. based research - This project should result in the development of early maturing, disease-resistant peanut varieties for use in North Carolina. The utilization of improved varieties with disease resistance will lower the cost of production and increase profits. This will allow the North Carolina peanut grower to compete more favorably in the world market.

GOAL

The goal of this project is to aid in the establishment of peanut breeding-pathology-agronomy programs in Thailand and the Philippines that are capable of developing and utilizing varieties that produce high yields under the cropping systems of Southeast Asia.

OBJECTIVES

Thailand - Objectives:

(1) To develop varieties with:

- Desirable agronomic traits of high yields, early maturity and drought tolerance, and

- Resistance to rust, Cercospora leafspots and *Aspergillus flavus*.

(2) To develop an agronomic system of production suitable for exploitation of new varieties in cropping systems of northeast Thailand.

Philippines - Objectives on peanut variety development for:

(1) Desirable agronomic traits of high yields, early maturity and drought tolerance and

(2) Resistance to rust, Cercospora leafspots, *Aspergillus flavus* and Sclerotium wilt.

Secondary objectives to be investigated as time and resources permit are to develop peanut varieties with adaptation to the following environmental stresses:

(1) Low soil fertility
(2) Partial shading
(3) Highly acidic soils
(4) Drought

The development of varieties high in nitrogen fixation capacity and resistant to insects is to be pursued collaboratively with activities under Plans of Work NCS/IM/TP-1 and NCS/TX/SM/TP-1.

ORGANIZATION

North Carolina State University

Dr. J.C. Wynne, Principal Investigator, Department of Agronomy, Raleigh, Breeder
Dr. H.T. Stalker, Cooperator, Crop Science Department, Raleigh, Breeder-Cytogeneticist
Dr. M.K. Beute, Cooperator, Department of Plant Pathology, Raleigh, Plant Pathologist
Dr. W.V. Campbell, Cooperator, Department of Entomology, Raleigh, Entomologist
Dr. G.H. Elkan, Cooperator, Department of Microbiology, Raleigh, Microbiologist.

Philippines

Institute of Plant Breeding (IPB)
Dr. Ricardo Lantican, Director and Coordinator of Project
Mr. Edilberto Redona, Senior Breeder
Ms. Leonila A. Lantican, Breeder
Dr. Lina Ilag, Senior Pathologist
Mr. Paningbatan, Pathologist
Dr. Candida Adalla, Entomologist

Dr. Virgilio Carangal, Director of the Cropping Systems Network at the International Rice Research Institute, serves as a cooperator on the project. He will test elite germplasm from the project in the Asian Cropping Systems Network.

The CRSP project in Thailand collaborates with a coordinated peanut improvement project administered by the Department of Agriculture but also involving Khon Kaen University and Kasetsart University. The Department of Agriculture has overall responsibility with research areas covering all components of production technology. The Department of Agriculture and the two universities have an informal agreement to coordinate research on peanut Collaborating personnel are as follow:

Thailand

Department of Agriculture
Dr. Arwooth NaLampang, Coordinator and Agronomist
Dr. Vichitr Benjasil, Peanut Breeder
Mr. Preecha Surin, Plant Pathologist

Kasetsart University
Dr. Aree Waranyuwat, Peanut Breeder
Dr. Tharmmasak Sommartaya, Plant Pathologist
Dr. Orapin Bhumibhamon, Microbiologist

Khon Kaen University
Dr. Aran Patanothai, Peanut Breeder
Dr. Sopone Wongkaew, Plant Pathologist

Dr. Ron Gibbons, Head of the Groundnut Improvement Program at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), will serve as a cooperator for the CRSP program for both countries. ICRISAT will provide technical advice, make germplasm available and assist in the training of both Thai and Filipino scientists.

Approach

Seeds of peanut germplasm from North Carolina, ICRISAT or other institutions with resistance to rust, leafspots, A. flavus, and Sclerotium wilt and with drought tolerance or early maturity will be introduced into both Thailand and the Philippines. The introduced germplasm will be grown in unreplicated nurseries. Observations on agronomic potential, disease and insect resistance, maturity and drought tolerance will be made. Selected lines will be grown in preliminary replicated tests to identify lines for further testing at multiple locations within each country. In addition to identifying lines for potential release as new cultivars, the results should also identify parents for hybridization programs.

Crosses between appropriate disease resistant, early maturing, or drought-tolerant germplasm and locally adapted varieties will be made to transfer disease resistance to adapted germplasm. Pedigree and backcrossing breeding procedures will be used to develop improved varieties.

Germplasm with both discriminatory (specific) and dilatory (general) resistance to leafspots and rust will be developed at North Carolina State University. As effectiveness of various resistance factors are verified, breeding will be initiated to determine heritability of factors, combining ability of multiple factors and efficacy of combined factors in various combinations.

Hybrid populations appropriate to the environments of Thailand and the Philippines will be developed at NCSU. Late generation materials will be evaluated in both countries for potential use.

In addition to the cultivated germplasm, interspecific hybridizations will be utilized to introgress desirable characters from the wild species into A. hypogaea. As 40-chromosome populations are developed, they will be incorporated into the A. hypogaea breeding programs. Developed germplasm will be evaluated in North Carolina, in Thailand and the Philippines for potential utilization. Improved varieties from the breeding projects will be submitted to the Asian Cropping Systems Network for testing in 11 Southeast Asian countries.

Short-term visits of Thai and Filipino collaborators to NCSU or ICRISAT will be made as needed. Candidates for M.S. or Ph.D. degrees will be identified and trained at NCSU. Short visits for technical training at ICRISAT will also be arranged as needed. Journals, books, reprints and other literature will be provided to the collaborators as needed.

ACCOMPLISHMENTS IN DETAIL

Thailand - After the visit of the CRSP planning team to Thailand, in anticipation of funding from I.D.R.C. and the CRSP, a coordinated Thai research program on peanut was organized. Although funding from the CRSP was not received until 1983, research under the coordinated program was initiated in 1982. The Department of Agriculture evaluated 480 germplasm lines for either aflatoxin, rust or Cercospora leafspot at the Kalasin Field Crop Experiment Station. Several lines from this nursery were selected for initial yield evaluations. Thirty-three lines from ICRISAT and Khon Kaen University were selected for earliness from initial 1982 tests and were evaluated in preliminary yield trials in 1983. Four preliminary yield trials were conducted by DOA in 1982. Entries were grouped for salinity tolerance, early maturity and drought tolerance, high yields and early maturation. Promising entries were selected from each group for further evaluation in 1983. Two groups of materials were tested in the standard yield tests in 1982. Nine entries from the first group were selected for regional testing. NC Ac 17121 was the highest yielding entry of the second group and will be further evaluated for use as a variety for fresh pod consumption. Five lines from the regional yield trials--RCM 387, Natal Common, Tainung No. 2, Natal and No. 15626 were identified as promising lines and will be further evaluated. In cooperation with the extension service, Moket, Panjab, Taiwan No. 2 and Tainan 9 were tested in farmers' fields. Tainan 9 with recommended cultural practices gave the highest yield.

At Khon Kaen University germplasm was tested before and after rice cultivation. Disease nurseries for rust and leafspot resistance screening were established. Promising material was selected and multiplied for evaluation by DOA. Among the advanced lines tested, superior entries were RCM 387, Moket and Tainung No. 2.

At Kasetsart University an advanced yield trial identified Shulamit, NC 2, Tifton 8, Georgia 119-20 and RCM 387 as superior lines. Selection for resistance to Aspergillus flavus was practiced among F_4 progenies in both the field and laboratory. Sixty-eight progenies were selected from the tests for further evaluation.

More than 2000 germplasm lines from North Carolina and ICRISAT were introduced into Thailand in early 1983. These will be multiplied at Kalasin and distributed to cooperators in the coordinated program.

The cropping systems project at Khon Kaen tested various cropping systems involving peanut. It was tested as an intercrop with cassava, in rotation after kenaf, in double cropping combinations with other crops and before and after rice in paddy fields. Peanut appear to be suitable for most of the cropping systems evaluated.

Disease research was also conducted by all three institutions during 1982. One hundred sixty peanut lines were tested for rust and leafspot resistance at Kalasin and Khon Kaen Field Crop experiment stations in the rainy and dry seasons. Variability existed among the entries with 23 lines having low rust scores and 60 lines having low leafspot scores. One hundred eighty-four entries were tested for their reaction to rust and leafspot at Khon Kaen University. Several entries were found to be resistant to both diseases. Peanut diseases during the growing season were monitored by planting Tainan 9 every 15 days beginning in mid-April for 12 planting dates.

Yellow mosaic, peanut mottle, early leafspsot, late leafspot, rust and seedling blight (Aspergillus niger) were the most prevalent diseases for all planting dates. Among the foliar diseases, rust was predominant at the early dates but was replaced by late leafspot in early September. In November, early leafspot was found to be most abundant.

Three potential candidates for the Ph.D. degree in plant breeding at North Carolina State University from the Department of Agriculture were identified and interviewed by NCSU researchers. One of these cadidates will apply to NCSU for the spring semester of 1984.

Arrangements were made for Dr. Aree Waranyuwat from Kasetsart University to visit NCSU and attend the American Peanut Research and Education Society meetings in North Carolina.

Philippines - Mr. Edilberto Redona was employed by the Institute of Plant Breeding as the peanut breeder to work with the CRSP. Approximately 50 accessions with known resistance to diseases or insects were introduced into the IPB program increasing the germplasm collection to 975. The introduced germplasm was evaluated in a nursery for disease resistance and agronomic characteristics. Promising lines will be entered in preliminary yield tests for two seasons. The best lines will then be entered into general yield tests for two seasons and regional yield tests in at least seven locations for at least two additional seasons. Results from the regional yield trials are the basis for varietal recommendations. Several promising lines including VPL Pn-4 have already been developed.

Arrangements were made for Mr. Edilberto Redona to visit NCSU during the 1983 harvest season. Mr. Redona will assist in selecting germplasm to be evaluated at IPB.

North Carolina - Approximately 200 breeding lines and 50 introductions were increased in North Carolina for distribution to collaborators in Thailand and the Philippines during 1983. These breeding lines include 24 lines from the cross of A. hypogaea and the wild species A. cardenasii. Crossing programs involving parents resistant to rust, leafspots, A. flavus, early maturity and drought tolerance and two adapted breeding lines from Thailand were completed during 1983. The segregating populations will be sent to Thailand and the Philippines for evaluation during 1983-84.

Seventeen species of section Arachis were evaluated for Cercospora arachidicola resistance in detached leaf studies in the greenhouse. Members of four species had very high levels of resistance, including A. chacoense (GKP 10602, GKSSc 30102), A. stenosperma (HLK 410), A. helodes (GK 30029) and A. diogoi (GK 30005). Although GKP 10602 was previously believed to have the highest resistance levels in section Arachis, other species collections (i.e., 30102, 30029 and 30005) had higher resistance levels, approaching immunity.

A hybridization program using NC 4 and Argentine with Arachis species was conducted during 1982-83. Pollinations (3,525) were made in an attempt to obtain hybrids with 20 species. One hundred twenty-six F_1 hybrids were identified from the previous year's crossing program, including hybrids with A. cardenasii (GKP 10017), A. chacoense (GKP 10602), A. spegazzinii (GKP 10038), A. correntina (GKP 9530)1, A. duranensis (K 7988), A. villosa (B 22585), A. batizocoi (K 9484), A. stenosperma (HLK 410), A. helodes (GKSSc 30031) and A. diogoi (GKSSc 30005). To restore fertility at the hexaploid

level, more than 2000 colchicine treatments were made and cuttings transplanted in the field. Fertile sectors must be identified and seeds harvested during 1983.

Thirteen 40-chromosome lines selected from an A. hypogaea x A. cardenasii hybrid population were evaluated in the field for Cercospora arachidicola resistance. As compared to resistant PI's, four selected lines had significantly fewer lesions per leaf. In a detached leaf study, sporulation occurred on less than 10% of the lesions of several lines. Although the agronomic potential of these selected lines is poor, the materials will be forwarded to Thailand for evaluation for resistance.

Interspecific hybrids between A. hypogaea x A. cardenasii and A. hypogaea x A. duranensis were evaluated for resistance to thrips, corn earworm, leafhopper and southern corn rootworm in cooperation with Dr. W.V. Campbell. Significantly high levels of resistance were found as compared to the cultivated parents. However, the levels of resistance in hybrid derivatives were not significantly better than in the insect-resistant cultivated line NC 343 and cultivar NC 6.

Several studies involving the development of methodology and resistant germplasm were conducted during 1982-83. These studies were as follows:

(a) Cercospora arachidiocola (early leafspot)

(1) Role of resistance factors - The purpose of this study is to determine the role of individual resistance factors (latent period, infection efficiency, sporulation amount and duration) affecting multigenic, infection rate-reducing resistance in selected peanut germplasms and breeding lines.

This study began with the selection of 20 peanut lines which exhibited moderate to high levels of resistance to early leafspot in North Carolina. Replicated plots for each entry are isolated from each other by eight rows of field corn. Leafspot incidence and percent defoliation is determined weekly. Disease-progress curves will be developed for each line (1982-). Rooted cuttings from field entries are being tested in greenhouse inoculation tests to determine which and how much each resistance component is contributing to the disease progress index developed from field tests.

Peanut lines in 1982 could be separated on the basis of incidence and defoliation curves over time (June-September). Greenhouse tests have only given data on infection efficiency at this time. Disease progression in the field in 1983 is occurring but severity values are of a lower magnitude due to a dry summer.

(2) Role of partial resistance - The purpose of this study is to quantify the role of partial resistance and evaluate the specific interaction between leafspot incidence and yield for individual lines. Six peanut entries exhibiting leafspot resistance are being tested (1982-) by application of five rates of fungicide (Bravo) and/or three schedules (14, 21 and 28 days) in a "fungicide equivalency" test. Data on disease progress (incidence of lesions, defoliation) are collected weekly from June-September. Yield is determined in October.

Analysis of 1982 results indicated that lesion incidence and defoliation interact with growth stage of peanut differentially for selected lines. Yield

of NC 5 in 1982 was minimally influenced by disease and/or fungicide rates but other lines responded with increased yields when disease was reduced by fungicides.

(3) Apparent infection rate - The purpose of this study is to characterilze the apparent infection rate (r) for C. arachidicola so that a better understanding of the epidemic will be possible. A basic study of the dynamics of C. arachidicola spread was initiated (1983-) in an area outside the peanut belt. Foci of infection were created in a 1-acre field by placing infected plant (pots) in the field, establishing unsprayed plots surrounded by fungicide-protected plots throughout the field, and following the movement of disease (infections) throughout the season.

The disease progressed well during the summer of 1983 but data are still being collected and no analyses have been conducted.

(b) Cercosporidium personatum (late leafspot)

The purpose of this study is to improve our ability to evaluate germplasm and breeding lines in greenhouse tests and to begin analysis of resistance components which are most useful in development of virginia-type peanut.

Work is being initiated to study effects of various environmental factors, plant age and plant genotypes on the role of specific resistance factors.

(c) Aspergillus control

The purpose of this study is to determine if A. hypogaea has potential for metabolic (physiological) resistance to Aspergillus fungi infection during active growth stages. Fourteen peanut lines were chosen for initial testing in field microplots. Plants are being grown under normal moisture and moisture-stress conditions. Soil moisture and temperature are recorded. Microplots were amended with a mutant isolate of Aspergillus which produces a red pigment in agar culture. Three sample dates are used to collect pods, pegs, fibrous and tap roots of entries (four replications/date) for bioassay.

Data from the first sampling indicate that all entries tested in 1983 became infected with the fungus. Differences, however, were observed between entries and among tissues assayed. The lowest percentage of pod infection occurred with NC 8C.

Two more samplings of plants will be made in 1983 (September and October). When all data are summarized, decisions will be made on selection of genotypes for 1984. Data on infection frequency will be compared with performance of dry pods in petri plate tests during the winter 1983-84 and each year thereafter.

PLANS FOR 1983

Efforts to provide technical information and more effective communication with our foreign collaborators will be increased during 1983. Copies of the PEANUT SCIENCE journal (back issues and current subscriptions), reprints of important journal articles and copies of the new peanut book PEANUT SCIENCE AND TECHNOLOGY will be provided to our collaborators. Dr. Aree Waranyuwat,

peanut breeder at Kasetsart University, Thailand, will visit North Carolina State University and several other U.S.A. breeding projects and attend the annual meetings of the American Peanut Research and Education Society. Mr. Edilberto Redona, peanut breeder at IPB, Philippines, will visit NCSU during the 1983 harvest. This will allow for further detailed planning of research projects in Thailand and the Philippines. A Ph.D. candidate from DOA will be accepted by the breeding project at NCSU. A second student in breeding from Khon Kaen or a student from DOA in Plant Pathology will also be accepted at NCSU during 1983.

Additional germplasm will be introduced into both countries. The introduced and already selected germplasm will be evaluated in yield trials in both countries. Selection for disease-resistant lines to be further tested or to be used as parents will be continued in both countries.

Crosses will be made in North Carolina and segregating materials will be provided for selection by breeders in Thailand. The research on plant diseases involving CRSP collaboration will be expanded in both countries based upon the findings of M. K. Beute who will visit both countries during 1983-84.

The interspecific hybridization project and the studies to identify resistance factors to leafspots will be continued in North Carolina. The work on screening aflatoxin resistance will be expanded in North Carolina to include hybridization among resistant lines and varieties adapted to Thailand and the Philippines.

"Management of Arthropods on Peanut in Southeast Asia"

North Carolina State University-Thailand and Philippines

W.V. Campbell - Principal Investigator, NCSU

INTRODUCTION

Insects are a major constraint on the yield of peanut. Insects, mites and millipedes form a distructive arthropod complex that defoliates the peanut plant, sucks the plant sap, and tunnels into and destroys the developing pods.

In North Carolina we have nine above ground insects and five soil inhabiting insects that destroy the peanut pegs and pods. In Thailand they list eighteen foliage and stem feeding insects and four soil insects important in peanut. The insect pests of peanut in the Philippines are similar in number and importance to those in Thailand.

Since many of the insects in North Carolina, Thailand and the Philippines belong to a common genera; their damage potential, habits and methods of management may be universal. Several insects in North Carolina and Southeast Asia are the same species.

Insect management practices, therefore, may be developed that should prove mutually useful and beneficial to North Carolina and Thailand and the Philippines.

MAJOR ACCOMPLISHMENTS

Project Establishment - The project was established and signed by the management entity, host country, principal investigator, and the North Carolina State University administrative offices. Thailand and the Philippines now have their share of the 1983 budget.

Research Results - Experiments were established in North Carolina, Thailand and the Philippines and data have been collected in North Carolina and Southeast Asia that will be reported in the 1984 Annual Report.

Results from an experiment in North Carolina to determine the effect of cultural practices on the insect complex show that cultivar, planting date and seeding rate affect the insect damage with cultivar and planting date having the greatest effect on insects.

EXPECTED IMPACT OF PROJECT

In host country - The project will increase the amount of research on the management of peanut insects; as a result will improve and enhance the present management strategies.

In North Carolina - We will be able to provide information to our peanut producers in a shorter time span than otherwise possible on management of insects on peanut. Some of this additional information will come from graduate students who will be supported by Peanut CRSP and who will be doing a thesis in some area of the Entomology Peanut CRSP.

GOAL

To provide information for the economical and environmentally sound management of insects and other arthropods on peanut and to enhance the current research that coincides and compliments the objectives of the Peanut CRSP.

OBJECTIVES

1. To evaluate an international collection of peanut germplasm for resistance to a complex of insects in cooperation with Dr. J.C. Wynne (Breeder, North Carolina State University) and entomology collaborators in Thailand and the Philippines.

2. Determine the damage potential of specific insects and the insect damage/plant phenological relationship (population dynamics) of important insects.

3. Determine the effect of cultural practices (planting date, seeding rate, row spacing, intercropping) on the insect population and damage to principal cultivars.

4. To establish insect/damage thresholds for the most important pests.

5. To develop a pilot pest management system that will incorporate information from the Peanut CRSP into existing peanut management systems.

ORGANIZATION

North Carolina State University

W.V. Campbell - Principal Investigator, Dept. of Entomology, Entomologist
J.C. Wynne - Cooperator, Plant Breeder

Thailand

Kasetsart University
Manochai Keerati-Kasikorn, Collaborator, Entomologist
Khon Kaen University
Aran Patanothai, Cooperator, Plant Breeder

Department of Agriculture
Arwooth NaLampang, Interim Coordinator
Sathorn Sirisingh, Collaborator, Entomologist
Pisit Sepsawardi, Cooperator, Entomologist

Philippines

University of Philippines, Los Banos
Eliseo Cadapan, Collaborator, Entomologist

National Crop Protection Center
Fernando Sanchez, Cooperator, Entomologist

Institute of Plant Breeding
Candida Adalla, Cooperator, Entomologist

Approach

Our pest management methodology in North Carolina, Thailand and the Philippines will be to conduct tests in areas where pests are endemic to take advantage of natural insect populations and the natural environmental interactions. This approach will minimize the need for laboratory and greenhouse space. However, some limited research will be conducted in the greenhouse and laboratory at all locations where field insect population pressure is not adequate or where refinement of data is needed and is not possible under natural field conditions.

We will conduct the research in the host countries in as many areas as possible where peanut is grown and for rain-fed and dry-land crops.

We will concentrate our research effort on the major pests in North Carolina and the host countries.

ACCOMPLISHMENTS IN DETAIL

Coordination of the research to minimize duplication of effort between the Department of Agriculture and Khon Kaen University Entomology Collaborators. The intent is a cooperative collaboration rather than intrusive relationship.

Establishment of a good working relationship with North Carolina scientists and Thailand and Philippine collaborators.

Establishment of tests in North Carolina, that are part of the Peanut CRSP, and in Thailand and the Philippines.

Funded one MS student through the CRSP and have one project underway that will be continued by a prospective graduate student.

Reprints and reports on insect management on peanut have been sent to collaborators in Thailand and the Philippines.

Arrangements were made for on-the-job training in insect management in North Carolina for Dr. Monochai Keerati-Kasikorn (Thailand) and Dr. Eliseo Cadapan (Philippines).

Catalogues and application blanks for admission to the North Carolina State University Entomology program were sent to Thailand and the Philippines.

PLANS FOR 1983

North Carolina Research

1. Evaluate international collections of peanut germplasm for resistance to thrips, potato leafhopper, corn earworm, southern corn rootworm and the twospotted spider mite.

2. Effect of cultural practices (cultivars, planting dates, row spacing, seeding rate and no-till peanut) on insect complex and insect damage.

3. Establish the action threshold (population/damage) for the potato leafhopper on major Virginia-type peanut.

Thailand (DOA)

1. Yield loss assessment and damage threshold.

2. Evaluate North Carolina germplasm for resistance to complex of insects.

3. Cooperate in studying the effect of cultural practices on insects and insect damage.

4. Chemical control of soil insects with minimum rates of insecticide.

Thailand (Khon Kaen University)

1. Evaluate international germplasm for resistance to leaf miner, leafhopper, Spodoptera, Heliothis and other insects.

2. Determine yield-loss assessment and threshold for the leaf miner.

3. Study the ecology of the subterranean ant, a major soil insect pest

4. Monitor major pests and study population dynamics.

5. Cooperate in cultural practices experiments and determine the effect on insects.

Philippines

1. Study pest population dynamics for major insects such as the leaf folder, leafhopper, etc.

2. Determine differences among Philippine-recommended cultivars and North Carolina cultivars in resistance to the insect complex.

3. Evaluate seedling resistance to major insect pests and develop techniques for insect resistance assay.

4. Study the biology and ecology of major insects.

Training (International)

The two host country Entomology collaborators will be given on-the-job training in pest management at North Carolina State University.

Two technicians from Thailand and one technician from the Philippines will be sent to ICRISAT for 30 days training in research methods in peanut and Entomology.

Training (National)

Two graduate students will be trained in insect pest management using Peanut CRSP funds at North Carolina State University.

"IPM STRATEGIES FOR PEANUT INSECTS IN SAT AFRICA"

University of Georgia -- University of Ouagadougou, Upper Volta

Robert E. Lynch, Principal Investigator, UGA

INTRODUCTION

Developing countries in SAT Africa offer great promise for expanded food production with their vast arabale lands suitable for agricultural production. At present, the primary goal of these SAT countries is to stabilize crop production. Often insects and insect borne diseases are associated with the unstable crop production. Research on the insects associated with peanut production and development of IPM strategies will aid in stabiiizing crop production in these countries.

MAJOR ACCOMPLISHMENTS

Establishment of Project

Dr. Robert Lynch traveled to Ouagadougou, Upper Volta in July, 1983 to establish a collaborative peanut research support program with the Institute Superior Polytechnique at the University of Ouagadougou, obtain signatures for the Work Agreement, and to discuss research plans and budget for the first year of the project. Collaboration was established with Dr. Albert Pation Quedrago, entomologist, at the University of Ouagadougou with assistance from Dr. Roudo Idrissa, plant pathologist.

EXPECTED IMPACT OF PROJECT

Research to define the major economic insects of peanut and development of IPM strategies within the socio-economic frame of the host country will reduce this direct threat to stability in peanut production.

GOAL

Identify the major arthropod pests of peanut, determine their relationship with aflatoxin contamination, develop economic thresholds for these pests, and develop IPM strategies and control measures to reduce losses to these pest.

OBJECTIVES

A. Identify the major economic pests of peanut.

B. Determine the relationship between level and type of arthropod damage with aflatoxin contamination in both preharvest and postharvest peanut.

C. Develop economic injury levels for the major arthropod pests by quantifying pest density with peanut yield.

D. Develop reliable sampling procedures to estimate population density of the major pests.

E. Determine arthropod abundance as related to peanut season and developmental phenology.

F. Provide opportunity for training for Voltaic students.

G. Develop bait attractants or other control strategies for major insect pests.

H. Evaluate promising breeding lines, developed by the Breeding CRSP, for resistance-susceptibility to major arthropod pests.

ORGANIZATION

University of Georgia

Dr. Robert E. Lynch, Principal Investigator, Southern Grain Insect Research Lab, Tifton, Entomologist

Institute Superior Polytechnique (ISP)

Dr. Albert Pation Quedrago, Collaborating Scientist, University of Ouagadougou.

Approach

During the first year of the Peanut CRSP, focus will be placed on three main objectives.

1. Survey the insect problems of peanut at six locations in Upper Volta to relate arthropod densities with peanut developmental phenology.

2. Evaluate local peanut varieties for arthropod damage using two different cultural practices common in Upper Volta.

3. Evaluate advanced breeding lines in the Breeding CRSP program along with local varieties for arthropod damage at the Gampala Research Station.

ACCOMPLISHMENTS IN DETAIL

Dr. Pation Quedrago has been designated the collaborating scientist with linkage with the I.S.P., University of Ouagadougou. Research will be initiated during the 1984 growing season.

PLANS FOR 1983

In 1983 and the 1984 growing season, research will be initiated as outlined in the Approach. The survey of arthropod problems will cover all of the major growing regions in Upper Volta, will be very intense to relate arthropod damage to peanut developmental phenology, and will include both pre-and postharvest arthropods. Two different techniques for bed preparation were noted during the trip to Upper Volta. These two techniques will be evaluated for effects on insects. The advanced breeding lines evaluated by the Breeding CRSP (Dr. Bill Branch, Principal Investigator) will also be evaluated for arthropod damage with local varieties included for comparison.

"Appropriate Technology for Storage/Utilization of Peanut

University of Georgia - Thailand and Philippines

Tommy Nakayama, Principal Investigator, UGA

INTRODUCTION

The storage and utilization of peanut appear to be constraints which exist in the delivery system in these countries. Technology of the developed countries, i.e. refrigeration, is not deemed appropriate because of the capital and energy costs. Therefore, the major thrusts of these projects are to investigate low cost methods of storage and their attendant consequences. Two particular methods will initially begin with storage in inert gases in laminated plastic bags and treatment of peanut by hot water blanching to enhance non-refrigerated storage stability.

Another major objective of the project is to measure baseline consumption data for the Thai population.

In both countries, peanut is not yet a major item of diet and are used chiefly in confections, sauces, etc. Research to enhance utilization by introduction or development of new food forms of peanut will be conducted.

MAJOR ACCOMPLISHMENTS

The project linkage has been established and work is underway with regard to the consumption survey and methodology for processing the data. Research is underway to investigate hot water blanching of peanut and use of inert gases in laminated plastic bags as methods of increasing storage stability.

Research results are too early to assess in view of the fact that the project has just started.

EXPECTED IMPACT OF PROJECT

In the host countries, the project, if successful in a most optimistic way, would enable peanut to be stored in edible form to lap over harvests. In this case, the time would be at least six months. Furthermore, the consumption data to be taken would form a reliable base on which to assess any increase in consumption in the future.

In the U.S., this will enable us to assess the acceptability of this type of storage method in the developing countries. It will give us information on storage for transport under inert gas and bag conditions. It will enable us to project possible future markets from the consumption data in these countries.

GOAL

The ultimate goal of the project is to enhance the capabilities of land-grant-type institutions in the third world countries. This is done through training afforded by collaborative programs in developing the storage and utilization of peanut.

OBJECTIVES

The objective of the training phase of the grant is to foster relations which would enable our counterpart departments in land-grant-type institutions in host countries to train students on their own. Consequently, emphasis is placed on training of graduate students in their country.

The objectives of the research phase of the project are to:

1. Collect and analyze consumption data
2. Devise appropriate technology for long-term storage of peanut.
3. Enhance utilization by introduction/development of new food forms of peanut.

ORGANIZATION

University of Georgia

Dr. Tommy Nakayama, Principal Investigator, Dept. of Food Science, Georgia Experiment Station
Dr. Bob Raunikar, Cooperator, Dept. of Ag. Economics, Georgia Experiment Station
Dr. David Wilson, Cooperator, Dept. of Plant Pathology, Coastal Plain Experiment Station
Dr. Whit O. Slay, National Peanut Laboratory, Dawson, Ga.

Thailand

Kasetsart University

Dr. Chintana Oupadissakoon, Principal Investigator, Department of Product Development, Faculty of Agro-Industry, Food Scientist
Dr. Sopin Tongpan, Cooperator, Dept. of Ag. Economics, Agricultural Economist
Mrs. Dara Buangsuwon, Cooperator, Dept. of Plant Pathology
Mrs. Vimolsri Devapalin, Oilseed Laboratory

Philippines

University of the Philippines at Los Banos

Dr. Elias E. Escueta, Principal Investigator, Food Technologist
Prof. Lilia Madamba, Cooperator, Food Chemist
Dr. Reynaldo Mabesa, Cooperator, Food Microbiologist
Mr. Roberto Reyes, Cooperator, Food Engineer

Approach

The baseline consumption data will be based on questionnaires collected by Thai workers. It is projected that there will be approximately 750 households surveyed. The data will be processed at the Georgia Station and results will be analyzed in both Thailand and the U.S. The storage studies will be carried out in the U.S., The Philippines, and Thailand, and on varieties indigenous to each region. The results will then be compared.

ACCOMPLISHMENTS IN DETAIL

Research results are not available at this time. The accomplishments are that equipment has been purchased and administrative details for approval have yet to be obtained. Funding has been initiated recently and some studies are currently underway. A short initial study on changes in surface structure of peanut which had been water blanched was carried out and examination by scanning electron microscopy indicated that changes in the structure of the surface cells did occur.

PLANS FOR 1983

It is expected that results from storage studies will be available at this time, as well as consumption survey data. It is planned to have results for microbiological stability as well as taste test data and chemical oxidation indices analyzed for storage by this time.

"Peanut Utilization in Food Systems in Developing Countries"

Alabama A&M University (subgrantee University of Florida) -
Caribbean Agricultural Research and Development Institute

B. Onuma Okezie, Principal Investigator, AAMU

INTRODUCTION

This project was scheduled to begin 1 July 1983, the second CRSP year. However, some preliminary work was done to facilitate timely initiation of the work.

MAJOR ACCOMPLISHMENTS

1. Developed and signed Plan of Work between Alabama A&M and the Management Entity.
2. Discussed subgrant plans with the University of Florida.
3. Planned visit to Caribbean Agricultural Research and Development Institute (CARDI) to formulate research plans and finalize Plan of Work-Host Country. Scheduled for July 1983.

EXPECTED IMPACT OF PROJECT

Improved dietary status of the populus in the Caribbean Region by a greater utilization of peanut as a major food source. An increased utilization would expand the market potential for farmers of the region.

The impact of the project in the U.S. could be two-fold. First, products and processes developed could have domestic application. Second, since most of the peanut consumed in the Caribbean is imported an increased consumption could increase the U.S. export market to the region.

GOAL

The major goal of this research project is to develop means for greater utilization of peanut as a direct food through determining the role of peanut as food items in diets, improvement of existing peanut food products, and development of new peanut food products.

OBJECTIVES

The overall objectives are:

A. Description and understanding of variations in environment, socioeconomics, and food technologies as they constrain the preservation and utilization of peanut supplies. Analysis of the current and potential dietary role of existing peanut products.

B. Assess the sensory, nutritional, microbiological and toxicological quality parameters of peanut and peanut products.

C. Incorporate indigenous peanut and peanut products into solid and/or beverage food systems locally consumed.

D. Prepare and present peanut fortified foods and determine acceptance and value of these products.

ORGANIZATION

Alabama A&M University

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Dr. Hezekiah S. Jones, Cooperator, Department of Agribusiness, Normal, Rural Economist
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University of Florida

Dr. E.M. Ahmed, Co-Principal Investigator, Department of Food Science, Gainesville, Food Scientist
Dr. H.S. Sitren, Cooperator, Gainesville
Dr. R. Schmidt, Cooperator, Gainesville
Dr. J.F. Gregory, Cooperator, Gainesville

CARDI

Dr. S. Parasram, Director of Research
Dr. St. Clair Forde, Administrative Liaison
Dr. George Sammy, University of the West Indies, Food Scientist

Approach

Alabama A&M will be responsible for accomplishment of the food consumption survey in cooperation with CARDI. The University of Florida as subgrantee to Alabama A&M will lead the product development research, which will be coordinated through CARDI with the food science researchers at the University of the West Indies, St. Augustine.

ACCOMPLISHMENTS IN DETAIL

Funding for this project was scheduled to begin 1 July 1983. Prior to this time some planning was done to help initiate the research early in the second project year.

The Plan of Work Alabama A&M University and the Management Entity was developed and signed by both institutions before 1 July. Alabama A&M held some discussions with the University of Florida related to the subgrant to Florida. Florida will be responsible for the product development portion of the project (objectives B, C, and D), and Alabama will conduct the food consumption survey to fulfill objective A..

Plans were made for Dr. Okezie and Dr. Ahmed to visit CARDI to discuss details of the project with the CARDI collaborators. (This was planned for July 1983, but later rescheduled for September).

PLANS FOR 1983

1. Tentative plans have been made to conduct the food consumption survey in December 1983.

2. A prime need emerged in the project discussions to establish laboratory capability for aflatoxin analysis and determine the extent of the aflatoxin problem in edible peanut in the Caribbean. This laboratory will be developed as soon as possible.

3. Product development research will begin, based on the results of the consumption survey. Some anticipated activities are:

   a. Examine quality, e.g. texture, taste, of stored peanut products especially when stored in plastic bags. Decisions on specific type products to work on will be made after the consumption survey results are available.
   b. Determine extent and severity of aflatoxin problem.
   c. Coordinate research efforts with extension groups to assure that efforts will be made to get new products accepted for public use.

"Rhizobia and Mycorrhizae Influence on Nitrogen Fixation and Growth of Peanut in Thailand and the Philippines"
A. Rhizobia Considerations

North Carolina State University - Thailand and Philippines

G.H. Elkan, Principal Investigator, NCSU

INTRODUCTION

Although a considerable amount of information on both the physiology and agronomy of peanut has been generated, a number of production management strategies remain to be explored. First, the potential of the Rhizobium-legume fixation system as a possible major source of the nitrogen requirement of peanut needs to be explored. Not much research has been conducted on Rhizobium technology so far. At present, certain studies are looking into the selection and identification of genetically compatible peanut variety-Rhizobium combinations capable of fixing N_2 over a wide range of environmental conditions. Others are on the determination of the inoculation requirement of peanut using Rhizobium strains from NCSU and other sources. Other peanut-Rhizobium strains that are effective and ecologically competent over a wide range of environmental conditions will be identified and isolated. Optimizing N_2 fixation in crop rotations (especially in a rice production system) and intercropping to supply sufficient N for the subsequent grain crop needs to be studied further.

MAJOR ACCOMPLISHMENTS

Although the soil microbiology project will officially be phased into the CRSP beginning year 2 (1984), there was considerable activity in this area as follows:

(a) Trips were made to Thailand and the Philippines by NCSU and TAMU PI's to organize the collaborative groups and outline the proposed research plans.

(b) Work plans and Memoranda of Understanding were prepared, approved and signed for Thailand and the Philippines.

(c) The first year research plans were implemented and field studies were begun at the overseas sites and laboratory and field trials were begun at NCSU.

(d) The NCSU principal investigator (G.H. Elkan) organized and taught, together with our Thai collaborators, a 2-week-long nitrogen fixation course for 20 Thai technicians so as to prepare more field research workers to help with the CRSP program. A similar course is being planned for the Philippines.

(e) Research related to the CRSP has been started (or is planned) in Indonesia, Malaysia, Burma and Cameroon. While these programs have no CRSP funding, we will continue to coordinate the BNF portions to strengthen the CRSP program.

(f) One of the NCSU investigators (T.J. Schneeweis) travelled to Cameroon to develop a peanut-BNF program there. Although, not CRSP funded this activitity contributes to the overall BNF efforts in peanut.

g) At NCSU the Rhizobium testing program has been expanded. Isolations of Rhizobium collections of nodules from tropically grown peanut are tested using a research protocol developed at NCSU. Promising cultures have been sent to the Philippines and Thailand for field testing and further development.

EXPECTED IMPACT OF PROJECT

Peanut yields in Thailand and the Philippines are about one-half of that in the USA. One major reason is due to the inefficiency of symbiotic nitrogen fixation. Improving available nitrogen levels will result in improved peanut yields. Preliminary experiments in Thailand and Malaysia have shown the potential of the Rhizobium-peanut symbiosis as a source of nitrogen in intercropping or crop rotation systems. Optimizing BNF, then, is of considerable importance to the entire food and feed production program of these countries.

Research under the project will concurrently lead toward optimizing BNF in U.S. peanut production.

OBJECTIVES

The primary goal of this research is to determine and remove the constraints to greater biological nitrogen fixation and productivity of peanut in Thailand and the Philippines. Specific research objectives are as follow:

(a) Identify rhizobial strains effective in symbiosis with local peanut cultivars from Thailand and the Philippines.

(b) Effect of flooding (rice rotation) on survival of rhizobia.

(c) Screen effective rhizobial strains and peanut germplasm for tolerance to soil acidity, high exchangeable aluminum and low available phosphorus for use in Thailand and the Philippines.

(d) Evaluate the need for inoculation for locally adapted peanut cultivars in field tests in Thailand and the Philippines.

(e) Determine the efficacy of inoculants prepared using strains identified as being effective with local peanut cultivars.

(f) Test the nitrogen fixing ability and yield potential of peanut germplasm derived from crosses of locally adapted cultivars and cultivars with high nitrogen fixing ability in Thailand and the Philippines.

(g) Evaluate the nitrogen fixing capacity and yield potential of peanut germplasm identified as most acid-tolerant to the acid soil conditions in Thailand and the Philippines.

(h) Introduce peanut cultivars and evaluate the potential for their production in the acid soils of Thailand and the Philippines.

Although each of the above objectives will be pursued, the major emphasis of the research will be concentrated on objectives (d), (e), and (f).

ORGANIZATION

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Dr. T.J. Schneeweis, Co-Principal Investigator, Department of Microbiology, Raleigh, Microbiologist
Dr. J.C. Wynne, Cooperator, Crop Science Department, Raleigh, Breeder

Texas A&M University

Ruth Ann Taber, Principal Investigator for Mycorrhizae, Department of Plant Pathology, College Station

Philippines

Institute of Biotechnology

Dr. Erlinda Paterno, Director and Coordinator of Project
Dr. Lina Ilag, Senior Pathologist

Institute of Plant Breeding

Dr. Ricardo Lantican, Director of the Institute
Dr. Edilberto Redona, Senior Breeder

Thailand

Department of Agriculture

Dr. Arwooth NaLampang, Coordinator and Agronomist
Mrs. Yenchai Vasuvat, Microbiologist
Dr. Nantakorn Boonkerd, Microbiologist
Dr. Omsup Nopamornbodi, Microbiologist

Kasetsart University

Dr. Orapin Bhumibhamon, Microbiologist

Khon Kaen University

Dr. Banyong Toomsan, Microbiologist

The Philippine project is coordinated through the Philippine Council for Agriculture and Resources Research Development (PCARRD) with the Institutes of Biotechnology and Plant Breeding.

The CRSP project in Thailand collaborates with a coordinated peanut improvement project administered by the Department of Agriculture but also involving Khon Kaen University and Kasetsart University. The Department of Agriculture has overall responsibility with research areas covering all components of production technology. The Department of Agriculture and the two universities have an informal agreement to coordinate research on peanut.

Dr. Ron Gibbons, Head of the Groundnut Improvement Program at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), will serve as a cooperator for the CRSP program for both countries. ICRISAT will provide technical advice, make germplasm available and assist in the training of both Thai and Filipino scientists.

ACCOMPLISHMENTS IN DETAIL

After consultation with collaborators, it was decided to select three peanut cultivars (NC 7, Tainan 9, and UPL Pn-4) and two Rhizobium isolates (32H1 and CB756) as internal standards in all experiments in Thailand, Philippines and North Carolina.

The following experiments have been established in nine field sites in Thailand and the Philippines:

(a) Determination of the number of rhizobia for inoculating peanut--A randomized complete block design will be used to evaluate the number of rhizobia per seed. The following treatments are used:

(1) Check (uninoculated)
(2) 10^5 cells rhizobia/seed
(3) 10^6 cells rhizobia/seed
(4) 10^7 cells rhizobia/seed
(5) 10^8 cells rhizobia/seed

Each treatment will be replicated four times. The plot size for each treatment is 3 x 5 m. The number of rhizobia in broth will be determined and appropriate dilution will be made to give the number of rhizobia per seed. The inoculated seeds of each treatment will be taken to determine the rhizobia. Again, after 3 days of planting, seeds and soil around the seeds for each treatment will be taken to determine the number of rhizobia. The number of rhizobia will be determined by fluorescent antibody (FA) techniques. Nodule number and mass for all treatments will be determined at 60 days after planting.

(b) Effect of residual nitrogen from azolla green manuring and nitrogen fertilizer applied on rice on N_2 fixation in peanut -A randomized complete block design consisting of four replications will be employed. Each replication will comprise the following treatments:

(1) Incorporating azolla at planting following a 3 week azolla growing period.
(2) Incorporating azolla 3 weeks prior to and at planting following two, 3 week azolla growing periods.
(3) Applying 35 kg N/ha
(4) Applying 70 kg N/ha
(5) Check (neither azolla nor N fertilizer).

Growing rice--Rice will be planted following establishment of the above treatments on 4.5 x 6 m plots. All plots will then be flooded.growing rice. The one with azolla will be inoculated once as a starter 3 weeks prior to rice planting.

Growing peanut--After harvesting rice, land in each plot will be prepared for growing peanut. Peanut seeds will be inoculated with rhizobia at the time of planting.

(c) Effect of various ratios of nodulation by effective and ineffective cowpea rhizobia on peanut--Cowpea rhizobia strains CB756 ineffective and T-1 effective will be used. The effective: ineffective ratios of 100:0, 90:10, 70:30, 50:50, 30:70, 10:90 and 0:100 will be employed. The experiment will be conducted in three field locations. The design of experiment will be a randomized complete block comprising four replications.

The nodules from each treatment ratios will be typed for effective and ineffective strains by FA or ELISA technique. Likewise, bacteroid protein of effective and ineffective strains per gram nodule will be determined. N_2 fixation, plant N and yield will be taken.

(d) Survival of peanut rhizobia in paddy field - The peanut cultivar Tainan 9 will be planted in a rice field in dry season (March). Peanut seeds will be inoculated with the most suitable strain or rhizobia before planting. After harvesting peanut, the peanut field will be plowed and irrigated (flooded). The field is then divided into two parts, one to be used for growing rice and another in which nothing is grown.

Soil samples will be taken for counting rhizobia by MPN-plant infection technique as follows:

(1) Ten samples of soil were taken before flooding.
(2) Appropriateness of soil samples at flooding time.
(3) Every 2 weeks after flooding, surface soil samples in both fields (growing rice and not growing rice) and soil samples at root zone of rice and weeds will be taken.
(4) Soil samples after harvesting rice and before growing peanut.

Peanut will be planted again after rice to check whether surviving rhizobia remain effective. A randomized complete block design comprising 10 replications with each replication consisting of two treatments of inoculation and non-inoculation will be employed. The area for each treatment will be 4 x 6 m^2. All treatments will be supplemented with P and K at the rate of 50 and 35 kg/ha of P_2O_5 and K_2O, respectively.

Two studies were established in Thailand as a result of our CRSP planning visits, but before the soil microbiology project was phased into the program. The first experiment evaluated the response of groundnut to inoculation of the best available Rhizobium strains. In this experiment, inoculations of mixed Rhizobium strains (TAL 169, TAL 1000, THA 201, and THA 205) were compared with nitrogen fertilization (16.4 kg N/rai) and control (without Rhizobium and nitrogen fertilizer) at two levels of PK basal fertilizer (9 kg P_2O_5 and 6 kg K_2O/rai, and 12 kg P_2O_5 and 12 kg K_2O rai). The experiment was conducted in a farmer's field in Chachoengsao Province and at the Khon Kaen Land Development Center. Results showed positive responses for pod yield and plant dry weight of peanut to Rhizobium inoculation and nitrogen fertilization when P and K fertilizers were applied. Nitrogen fertilization reduced nodule formation to some extent, but Rhizobium inoculation resulted in an increase in nodule formation.

The second experiment was a comparison of Rhizobium inoculation and fertilizer application for peanut in farmers' fields. The treatments included Rhizobium alone, Rhizobium plus 9 kg P_2O_5/rai, 3-9-6 fertilizer, and check. The trial was conducted in large plot (20 x 20 m), unreplicated, in farmers' fields in three provinces (Chachoengsao, Nokhon Ratchasima, and Lampang). Results showed similar yield responses to Rhizobium inoculation and phosphorus fertilizer and the 3-9-6 fertilizer treatments, but the Rhizobium inoculation and phosphorus fertilizer would cost less and give higher net return.

A research emphasis in our laboratory involves the isolation, evaluation and dissemination of promising rhizobia for peanut. Isolation of rhizobia from native legumes is the most practical method of obtaining a heterogeneous population of strains that usually vary both in nitrogen-fixing potential and response to environmental factors.

Nodules from plants of the genus Arachis are continually being obtained by germplasm collecting expeditions sponsored by the International Board for Plant Genetic Resources and several South American countries. These collectors placed nodules in previously prepared 7.5-ml plastic vials containing anhydrous calcium chloride covered with a cotton plug. Strains were isolated from these nodules and are evaluated for their nitrogen-fixing ability and response to environmental factors. Likewise, nodule collections from Thailand, Philippines, Malaysia, Gabon, Cameroon and other tropical sources are being screened.

Strains isolated from these nodules are identified as Rhizobium through nodulation tests since this is the only certain method of identifying rhizobia. Several test plants other than the actual host can be used in determining the nodulating capacity of a particular strain. Siratro (Macroptilium atropurpureum) grown in 180-ml urine specimen bottles capped with plastic bags is used in our laboratory to identify rhizobia of the cowpea group.

The effectiveness of a rhizobial strain must be measured in plant tests. Generally two or more diverse peanut hosts are used in initial testing. Preliminary assessment of the nitrogen-fixing ability of strains of Rhizobium is conducted in modified Leonard jars in the greenhouse. The jars and a 1:1 sand: vermiculite medium are autoclaved before use to prevent contamination.

Peanut seeds of each genotype are surface-sterilized and then pregerminated in sterilized vermiculite and placed in the jars. Before covering the seed, a suspension of the proper rhizobial strain is added aseptically to the seed for all treatments except for an uninoculated control where sterile culture medium alone is added to the seeds. A nitrogen control is also included. Treatments are generally replicated five times with plots arranged in a randomized block design in the greenhouse. Nutrient solution is added twice during the growing period. After 50 days of growth, the plants are harvested. Plant color is rated. Nitrogenase activity is measured for the root system of each plant using acetylene reduction methodology. Nodules are counted and removed so that nodule mass can be determined. The roots and plant tops are dried and weighed. In earlier tests, tops were ground for determination of nitrogen using the Kjeldahl technique; however, this is not always done since dry weight and nitrogen content were highly correlated.

Promising strains from the growth chamber study are next tested for their ability to form an effective symbiosis with the cultivar NC 2 in the greenhouse using the procedures previously described. Several of the strains were as effective as the control inoculant, suggesting that this new Rhizobium germplasm may be useful in developing inoculants for improved peanut cultivars.

With the collaboration of Dr. J.C. Wynne, these isolates are being tested in field studies. We have developed a formal procedure for field evaluation of rhizobial strains. In field studies conducted on soils supporting large populations of endemic rhizobia, single strain isolates significantly influenced nodulation, nitrogenase activity and plant dry weight. Strains both less and more effective than the naturally occurring rhizobial population have been observed. This approach has been effective for obtaining improved nitrogen fixation rates for peanut grown in the United States. Additionally, promising rhizobial isolates and promising cultivar x Rhizobium combinations have been sent to our CRSP collaborators. To date, 150 Rhizobium isolates have been run through the testing procedure and another 100 isolates are in various evaluation stages.

Evaluated isolates are also sent upon request to other LDC workers. Some of these have been field tested on site with promising results. For example, one of our isolates, NC92, is being used as in inoculum for Robut 33-1, a commercial peanut cultivar in India (field tests were conducted at ICRISAT). In some 18 field trials in various soils containing endemic rhizobia, this cultivar-Rhizobium combination resulted in significant increases in pod yield. This is a very specific cultivar x bacterial isolate interaction. Robut 33-1 and NC92 are presently under test in eight countries including CRSP locations. In our laboratory we are using this symbiosis to determine the biology of the interaction.

PLANS FOR 1983

Research projects described in the Accomplishment Section will be completed and most will be repeated in the 1984 growing season.

"Rhizobia and Mycorrhizae Influence on Nitrogen Fixation and Growth of Peanut in Thailand and the Philippines"
B. Rhizobia Considerations

Texas A&M University - Thailand and Philippines

Ruth Ann Taber, Principal Investigator, TAMU

INTRODUCTION

Mycorrhizal fungi inhabit the roots of almost all terrestial plants, including important crop plants such as peanut. Mycorrhizal fungi aid plant growth by functioning as accessory roots. In some plant species these fungi have been shown to promote solubility and uptake of minerals (especially phosphorus); protect plant roots from disease; produce growth-promoting hormones; increase salt, drought, and flooding tolerance; and may act synergistically with Rhizobium on legumes. The relative efficiencies of these fungi in peanut are relatively unknown. Endomycorrhizal fungi have been reported in peanut roots - in Texas, five species representing 3 genera (Glomus, Gigaspora, and Sclerocystis) are recognized as associative with peanut, although their value has never been assessed. A better understanding of the various endomycorrhizal fungi present in the roots of peanut both in the LDC's and in Texas and North Carolina is urgently needed.

MAJOR ACCOMPLISHMENTS

Establishment of the project

A coordination trip to Thailand and the Philippines was completed in early 1983. In the Philippines, a field trip was made to the northern part of Luzon (to Tuguegara and Cagayan by airplane) in order to observe peanut in the field and collect samples. Meetings were held with cooperating scientists, directors, and staff at PCARRD/UPLB/SEARCA. The Memorandum of Understanding was signed February 3, 1983. Conferences were held with cooperating scientists in the Philippines and future plans and considerations were discussed.

In Thailand, meetings were held with staff of the Department of Agriculture and Kasetsart University. Conferences were held with the Soil Microbiology group, experimental procedures were outlined, and the Memorandum of Understanding was signed February 8, 1983. On the return trip to the U.S., the Niftal laboratory in Maui, Hawaii was visited and phone contact was made with Dr. Bohool in Honolulu.

A second trip to the Philippines and Thailand was made in August, 1983. Additional contacts were made with cooperating scientists and information concerning our mycorrhizal research progress in Texas was reviewed. Further needs and plans were discussed. In Thailand, a field trip was made to mycorrhizae-inoculated plots north of Bangkok. During the International Plant Pathology Congress in Melbourne Australia, conversations with Dr. Norman Schenck, University of Florida, have resulted in plans to cooperate on our respective projects in Thailand and mutual agreement was reached on benefits we may derive from our cooperative mycorrhizae research efforts on peanut and rice.

Three graduate students and one technician have been added to our group to further advance research progress.

Research Results

1. Pot cultures of mycorrhizal fungi in LDC collections were started.

2. Pot cultures of unidentified mycorrhizal fungi have been established in the greenhouse at Texas A&M.

3. Pot cultures were started from a number of identified (known species) mycorrhizal fungi, including several obtained from Dr. Norman Schenck, University of Florida.

4. Ten peanut cultivars (U.S.) were planted at 4 locations in Texas, including West Texas (El Paso) where high salt and drought conditions prevail. These cultivars will be assessed for mycorrhizal fungi acceptance. Pot cultures will be established in the greenhouse from spores found adjacent to roots and from soil in toto.

5. Twelve Philippine cultivars were planted (in boxes only) to increase seed.

6. Soil samples were collected from 35 locations in Texas (see Fig. 1), representing predominant soil types and especially the high salt soils. Mycorrhizal pot cultures were established. Several good cultures were obtained from the high salt areas and inoculum increases are being grown in flats.

7. Spores sieved from LDC soils were brought to Texas for examination.

EXPECTED IMPACT OF THE PROJECT

In host country - An increased understanding of these beneficial fungi should lead to improved peanut growth and yield in LDC's. Utilization of appropriate, efficient strains of these fungi should allow for peanut plantings in the more arid regions, in areas where soil fertility is low, and increase the value of peanut in intercropping sequences.

In United States - Knowledge of efficient mycorrhizal fungi, access to untested strains, and methodology developed as a result of this project should lead to development of inoculation procedures to assure the presence of appropriate fungi on peanut to obtain maximum yields. In addition, discovery of mycorrhizal strains adapted to soils with high salt contents, low water potentials or flooded conditions could help farmers use land currently unsuitable for peanut growth.

GOAL

To increase peanut yield/unit area in the LDC's and the U.S.A. through manipulation of mycorrhizal fungi in peanut roots and to bring into production acreages presently idle because of lack of sufficient water, high salts in the soils, or flooding conditions.

OBJECTIVES

A. The overall objective is to help maximize peanut production in each country through manipulation of the microbial inhabitants of the root.

B. Conduct a collaborative survey of endomycorrhizal fungi predominant in rhizosphere of peanut growing in the U.S. and LDC's.

C. To establish a collection of mycorrhizal fungi in pot culture, develop inoculation techniques, and field test various mycorrhizal isolates.

D. Establish the effectiveness of selected mycorrhizal fungi for alleviating salinity, drought, and flooding stresses in peanut.

E. Establish the effectiveness of selected mycorrhizal species for increased uptake of phosphorus.

F. Determine whether mycorrhizal fungi can afford the peanut protection against soil-borne diseases.

ORGANIZATION

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Esker Arvanetes, Timothy Riley, Stephen Neck, Graduate Students, College Station
Suzanne Segner, and Shan Zaggle, Technicians, College Station

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Dr. Thomas Schneeweis, Cooperator, Raleigh

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Dr. Banyong Toomson
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Philippines

University of the Philippines at Los Banos (UPLB)
Dr. Lina Ilag
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Philippine Council for Agriculture & Resources Research & Development (PCARRD)
Dr. D.P. Gapasin
Institute of Plant Breeding
Dr. Ricardo Lantican
Dr. Edilberto Redona

Approach

Mycorrhizal spores will be sieved from soils and used to start single-membered mycorrhizal pot cultures. Trap plants (e.g. Sorghum vulgare) will be seeded to inoculated potting soils in the greenhouse. Established cultures will be increased in flats in the greenhouse, and peanut in the field will be inoculated in furrow or through seed coating before planting. Peanut yields and seed quality ratings will be obtained. A study will be made of the invasion of weed seeds in the soil by mycorrhizal fungi and their importance as inocula sources in the soil. Improved techniques to assess extramatrical mycorrhizae hyphae will be developed.

ACCOMPLISHMENTS IN DETAIL

1. Assessment of problems that peanut experience under salt and drought pressures in Texas (El Paso)

1. Peanut cultivars planted at an alkaline location (10" RF/yr) and irrigated with 3000 ppm salt water (Rio Grande River), were chlorotic and stunted. Peanut varieties differed in their degree of chlorotic response. Foliage of the Florunner and NC 8C cultivars were less chlorotic. Amount of foliage (wet weight basis) differed significantly among cultivars. Foliage weights of PI 300590 and Florunner peanut plants exceeded that of PI 337409, NC 8C, and PI 365553. Poorest foliage weights were recorded for Toalson, PI 296551, Starr, and TP 107271Y. Pod set differed with each cultivar. Sclerocystis sinuousa sporocarps predominated in the rhizosphere. Aspergillus niger seedling disease was rampant. No Rhizobium nodules formed on any roots. No leaf spots had developed on the leaflets at 4 months.

2. Greenhouse Pot Cultures

1. Pot cultures of several known and unidentified species of mycorrhizal fungi were established.

2. Additional pot cultures from mycorrhizae spores collected in Thailand and the Philippines were started.

3. Field trips were made in Southeast Asia to observe peanut under cultivation. In the Philippines, Aspergillus niger seedling blight, Cercosporidium personatum leafspots, Cercospora arachidicola leafspots, rust (Puccinia arachidis), southern blight (Sclerotium rolfsii), Rhizoctonia pot rot, and Choanephora leaf and petal blight were observed. In Thailand, Rhizoctonia pod rot, Aspergillus niger seedling disease, and leafspots were observed. Plots inoculated with rhizobium and mycorrhizal fungi were inspected north of Bangkok. Plants were still young and it was too early to assess differences.

4. Mycorrhizal spores from Thailand were brought back to the U.S. Gigaspora and Glomus species were identified. Characteristics and general morphology of the spores are being documented for species identification.

PLANS FOR 1983

(a) Grow Philippine and Thai seed in quarantine to increase seed.

(b) Collect spores for ELISA technique to be carried out in Thailand.

(c) Continue inoculating spores and/or other inocula to obtain mycorrhizal pot cultures.

(d) Further analyze mycorrhizal infection in peanut varieties in the 4 test locations in Texas. Add Rhizobia to plots in 1984.

(e) Plant standard peanut cultivars in the greenhouse and inoculate with mycorrhizal fungi.

(f) Set up experiments to determine phosphorus requirements of peanut varieties under study. Phosphorus requirements will be determined with varying levels of other nutrients.

(g) Obtain additional mycorrhizal spores from Southeast Asia for identification and assessment in Texas.

(h) Send mycorrhizal fungi to Southeast Asia for assessment under their greenhouse conditions.

(i) Describe invasion process of mycorrhizal fungi into seeds in soil.

(j) Set up instrumentation for monitoring water levels in pot cultures in the greenhouse. Initiate studies to monitor mycorrhizal fungus penetration into peanut roots under various moisture levels.

(k) Set up instrumentation to monitor changes in electrical conductivity in pot cultures in the greenhouse.

(l) Arrange to spend 3-4 weeks in Southeast Asia to work in the laboratories and fields with our collaborators.

(m) Set up greenhouse experiments to test the ability of select mycorrhizal fungi to reduce the severity of soil-borne diseases of peanut.