

PD-AAZ-745
62470

Annual Progress Report

1982

RESOURCES SUPPORT SERVICES AGREEMENT BETWEEN
AGENCY FOR INTERNATIONAL DEVELOPMENT
and
U.S. DEPARTMENT OF AGRICULTURE

RSSA USDA 4-76

Beltsville Rhizobium Study and Collection Center
USDA ARS
Nitrogen Fixation and Soybean Genetics Laboratory
Plant Physiology Institute
Beltsville Agricultural Research Center
Beltsville, Maryland

D. F. Weber and H. H. Keyser

Annual Progress Report - CY 1982

RSSA USDA 4-76

Current Staff:

Deane F. Weber, Microbiologist and Principal Investigator

Harold H. Keyser, Microbiologist

Richard F. Griffin, Biological Laboratory Technician

Alan Sandler, Biological Aide ($\frac{1}{2}$ time)

I. OVERALL OBJECTIVES

1. Collection, characterization, documentation and preservation of Rhizobium

In 1982, 37 strains were added to the collection, including 5 R. japonicum, 2 R. leguminosarum, 2 R. phaseoli, and 3 cowpea rhizobia. J. C. Burton deposited 19 isolates of R. trifolii, including native California isolates that are ineffective, effective, and competitive isolates, as well as other key strains of R. trifolii.

We collaborated with American Type Culture Collection in the verification of the type strains (Bergey's Manual) of Rhizobium which they keep.

Greenhouse studies with lima bean rhizobia in symbiosis with cv. Jackson Wander demonstrated the production of ureides in the symbiosis, and plant ureide concentration was well correlated ($r = 0.91$) with total plant N. Since the plants were grown in N-free medium, this means that ureide concentration in the lima bean correlated well with nitrogen fixation in comparison to the correlation between acetylene reduction and total plant N ($r = .60$). The work was done in cooperation with Dr. Peter van Berkum.

Evaluation of symbiotic effectiveness among rhizobia from Leucaena leucocephala, Coronilla varia, and Onobrychis viciaefolia showed almost complete cross nodulation between the hosts, but definite specificity for effectiveness. Of the nine Leucaena isolates only one was ineffective on Coronilla varia, the rest being fully effective and all were effective with Leucaena. In contrast, none of the eight Coronilla isolates was effective on Leucaena, but all were effective on their homologous host. Both of the Onobrychis isolates were ineffective on Leucaena and Coronilla.

Continuing examination of acid and aluminum tolerance in rhizobia showed that leucaena-crown vetch, peanut, and soybean rhizobia were acid and Al tolerant, while clover and bean rhizobia were very sensitive to Al though tolerant of pH 4.5. Two strains each of peanut and soybean rhizobia were grown in tatum acid-Al soil and displayed over 1000-fold decrease in viable cells when the pH was less than 4.5. Even at this low pH, rhizosphere population levels were approximately 10-fold higher than in adjacent soil.

In cooperation with B. Ben Bohlool and Mike Sadowsky, a study was conducted comparing biochemical relatedness of fast- and slow-growing soybean rhizobia. While both the fast- and slow-growing rhizobia were positive for catalase, urease, oxidase, nitrate reductase, and penicillinase, the fast-growing R. japonicum grouped with other fast growing rhizobia in that they were tolerant of 2% NaCl, were capable of growth at pH 9.5, utilized a large variety of carbohydrates (notably disaccharides), and produced serum zones in litmus milk. In addition, these fast-growing strains were similar to other fast-growing species of Rhizobium in that they had appreciable levels of β -Galactosidase and NADP-linked 6-phosphogluconate dehydrogenase but no detectable hydrogenase activity. Although the fast-growing soybean rhizobia share symbiotic host specificity with the typical slow growers, they appear biochemically more closely related to the other fast-growing species than to the typical slow-growing R. japonicum.

Rhizobium isolates were obtained from nodules of Acacia albida that were planted in an ultis^cal soil from Beltsville. These isolates were studied in cooperation with Dr. L. Jackson (USDA, Peoria, IL) with regard to extracellular polysaccharides, R. japonicum serogroup identity and nodulation of soybean. Identical extracellular 4-O-methyl-D-glucurono-L-rhamnans are formed by some Rhizobium japonicum strains isolated from soybean root nodules and by rhizobial isolates from Acacia albida, Vigna radiata, and Desmodium sp. Composition and methylation analyses demonstrated identity to the structure determined by Dudman. In this acidic heteropolysaccharide, the tetrasaccharide repeat unit is a 4-O-methyl-D-glucuronosyl side-chain residue appended to a 1,3,4-tri-O-substituted L-rhamnose residue in a main chain that also contains (1→3)- and (1→4)-linked L-rhamnosyls. The Acacia albida microsymbionts, Rhizobium sp. NRRL B-4591, NRRL B-4592 and NRRL B-4593, were classified in R. japonicum serogroups 94, C2 and C3, respectively. This classification is a function of somatic antigen and is independent of the extracellular polysaccharide. All three strains from A. albida as well as the one from Desmodium sp. nodulated soybeans effectively.

In cooperation with S. L. Uratsu, University of California, Davis, a survey was conducted in 1980 on 972 B. japonicum (formerly Rhizobium japonicum) isolates obtained from 323 soybean root nodules from 65 locations in 12 states. Isolates were examined for hydrogenase (Hup) phenotype by the tritium assay, and for their somatic serogroup identity in agglutination tests with 15 antisera from serological type strains. Only 20% of the isolates were Hup+ and a majority of Hup- isolates were found within 10 of the 12 states, confirming the results of a previous survey. Only 9.8% of the isolates did not react with any of the antisera tested. The most predominant serogroup was c3 (21.5%), followed by USDA123 (13.6%). Of the 59 isolates belonging to serogroup 135, all were Hup-, while 86% and 100% of the isolates in

serogroups USDA122 and 38-122 were Hup+, respectively. Most serogroups contained Hup+ and Hup- isolates. The presence of more than one serogroup was found in 10.8% of the nodules, and 9.3% of the nodules contained different Hup phenotypes within the same serogroup.

Permanent preservation of the collection is proceeding well. The goal is to have the entire collection preserved in two parallel states - lyophilized and in glycerin at -80°C. So far this is completed for the R. japonicum and all recommended strains for the major legumes. Associated evaluation on host legumes continues, and a revised catalogue is projected for late 1983.

2. Distribution of cultures of Rhizobium for research and inoculum production in DC's and LDC's.

In CY 1982, the collection distributed 842 cultures of Rhizobium for 124 requests, serving 26 countries. Eleven private companies (inoculant manufacturers and biotechnology firms) requested cultures. The remainder of the requests were from private, local, state, or federal research institutions.

Summary of 1982 Rhizobium requests:

R. japonicum	483 cultures	(57%)
'Cowpea' rhizobia	221 cultures	(26%)
R. phaseoli	47 cultures	(5.6%)
R. leguminosarum	36 cultures	(4.2%)
R. meliloti	31 cultures	(3.7%)
R. trifolii	24 cultures	(2.9%)

Below is a summary of Rhizobium requests serviced by the collection over the last 7 years:

<u>Year</u>	<u>Requests</u>	<u>Cultures</u>
1976	31	193
1977	61	320
1978	47	227
1979	69	515
1980	57	508
1981	117	765
1982	124	842

3. Serve as a depository for microbial germplasm

Dr. J. C. Butron deposited 19 isolates of R. trifolii for incorporation into the collection.

4. Train researchers and technicians in techniques and subject matter for applied research and technology of Rhizobium biology and consult with and provide technical assistance to those who work with rhizobia in LDC's.

In CY 1982, Dr. Seydou T. Sanagho (from Mali) finished his training and research in Rhizobium competition, inoculant preparation, strain evaluation, and serological identification. Subsequently, Dr. Sanogho has taken a job in Zambia. The NIFTAL-subcontracted job deals with Rhizobium inoculant production, field evaluation of strains, and other applied aspects.

In November 20-28, 1982, Dr. Weber accompanied J. Gritzner and C. Corrillan of NAS to Senegal. The purpose of the trip was to consult with Senegalese officials on the newly established MIRCEN at Bambey and to visit the tree legume trial sites in Senegal.

Also, Dr. Keyser cooperated with J. Gritzner in preparing a protocol and sampling kit for soils from W. Africa where the tree legumes are to be tested. The soil will be tested at Beltsville for indigenous Rhizobium, numbers, identity and effectiveness.

II. RESULTS OF RHIZOBIUM FIELD TRIALS

1. Rhizobium-lima bean trial conducted at Upper Marlboro, Maryland, granular inoculant.

'King of the Garden'	
<u>Nitrogen source</u>	<u>Yield-kg shelled/16' row</u>
150 lbs nitrogen	1.86 a
USDA3258	1.82 ab
NAPB mix	1.76 abc
TAL 22	1.72 abc
USDA3317	1.69 abc
USDA3259	1.61 abc
USDA3257	1.59 abc
USDA3313	1.58 abc
USDA3315	1.49 bc
Uninoculated	1.43 c

The same treatments applied to cv. Bridgeton and Fordhook 242 gave no significant differences in yield.

2. An observation trial was conducted at Upper Marlboro with Voandzeia subterranea, Canavalia ensiformis, and Vigna acontifolia. While V. subterranea grew poorly, the other two species grew very well, and in contrast to other legumes in the field were virtually untouched from pests. Both C. ensiformis and V. acontifolia showed a nodulation response to a mixture of effective lima bean rhizobia. Also, V. acontifolia set pods and developed mature seed, indicating that it can be used in future field tests.

Soybean-Rhizobium field trials conducted at Maryland Tobacco Research Station, Upper Marlboro, Maryland 1982. Seed applied peat inoculant.

<u>Essex</u>		<u>Kent</u>	
<u>Strain</u>	<u>Yield (bu/acre)</u>	<u>Strain</u>	<u>Yield (bu/acre)</u>
USDA 122	43.8	PRC 113-2	34.7
R54a	43.5	PRC 127	34.1
587	40.8	J507	33.6
J507	40.6	PRC 160	33.6
PRC 160	40.2	R54a	31.4
29W	39.9	USDA 143	31.2
CB 1809	39.8	29W	31.2
PRC 113-2	39.6	CB 1809	31.0
PRC 127	39.3	PRC 3	31.0
USDA 142	39.3	USDA 110	30.6
Y1a	39.3	587	30.5
USDA 110	39.1	WB 69	30.0
USDA 143	38.9	PRC 143	29.9
WB 19	38.1	WB 19	29.8
USDA 138	37.0	USDA 142	29.8
USDA 6	36.1	USDA 6	28.9
WB 69	36.1	USDA 122	28.6
PRC 3	35.4	USDA 138	28.1
PRC 143	35.2	Y1a	27.4
USDA 31 (Control)	33.7	Non-nod Clark	26.2
Non-nod Clark	26.2	USDA 31 (Control)	23.3

PROJECT REVIEW SUMMARY

PROJECT TITLE: World Rhizobium Collection Center

DATE OF REVIEW 10/23-24/80

PROJECT NO. 931--095

OSB OFFICE/DIV. AGR/RNR

List actions to be taken (or issues to be resolved) as a result of Project Review Meeting	Action Officer	Date Action to be Completed
1. Continue program with FY 81 funds. PIO/T to be drafted 11/80.	L. Frederick	12/80
2. Progress is satisfactory		

Lloyd R. Frederick 11/18/80
Project Manager

DS/AGR/RNR Lloyd R. Frederick
DS/AGR/RNR: CS Mkins
DS/AGR: JWalker
Attachments: OSB Project Data Sheet
Project Review Information Sheet
Others:
DS/AGR: MMozynski

Office Director
DS/AGR Don Fiester
Distribution: Project Files
DS, OAA
DS/PO: Program Analyst

PROJECT REVIEW INFORMATION

PROJECT TITLE World Rhizobium Study and Collection
Center

DATE OF REVIEW 11/7/80

PROJECT NO. 931-0095

1. Briefly state principal subject(s) to be discussed during the review.

Characterization of rhizobia by field tests - satisfactory progress
Intern training - Thailand scientist
International linkages and coordination with other BNF activities
Activities under project
See Summary Statement attached

11. Please respond to the following questions. Additional detail can be given below if warranted or necessary.

- a. Is project implementation on schedule as planned in the PP or implementation plan? Satisfactory but has been delayed due to staffing problems in BARC/USDA
- b. Are there any short falls or delays of project inputs? USDA has had difficulty in establishing microbiologist and in providing appropriate
- c. Are project assumptions holding up? /travel; progress now satisfactory
yes
- d. Are progress/annual reports being submitted in a timely fashion? delayed
Are such reports informative? yes
- e. Is there any monitoring/progress information being received from other than project or contractor personnel (a.g., project manager site visits, USAID reports etc.)? yes, site visits, other scientists
- f. Has an evaluation been carried out? yes
- g. Are there any audit or evaluation recommendations outstanding? no
- h. Are there any special or restrictive requirements imposed by RAC or stipulated in the PP? no

Summary Statement

The World Rhizobium Study and Collection project at Beltsville provides the following services to AID.

1. Safe, permanent and comprehensive collection of Rhizobium cultures available at Beltsville.
2. Acquisition of cultures from worldwide sources to provide cultures of value in study and production of all agriculturally important legumes.
3. Characterize cultures with an objective of selecting superior cultures for field conditions.
4. Enumerate and catalog rhizobial cultures to improve accessibility for LDC researchers.
5. Distribute cultures and information on BNF as requested.
6. Train researchers and technicians in applied Rhizobium biology.
7. Study ways to more effectively use Rhizobium cultures by inoculation in field situations.

Accomplishments include:

1. Collection of Rhizobium isolates: The Center received new germplasm from collection of expeditions (by others) to the Mediterranean area and the People's Republic of China. Also, the Center received many isolates for tropical legumes from other major Rhizobium centers in Brazil, Colombia, Australia, England, Hawaii, Spain and South Africa.
2. The Center characterized the performance on legumes of newly acquired germplasm for lima bean, mung bean, cowpea, Siratro, alfalfa and soybean. In some cases, strain characterization included tolerance to acidity and aluminum, and energy efficiency rating via hydrogen evolution from nitrogenase activity. New soybean rhizobia were also serologically identified.
3. The Center published the first public listing of its collection in December, 1979, with the USDA - Beltsville Rhizobium Culture Collection Catalogue. The catalogue is being distributed on a world-wide basis.
4. The Center is serving as a depository for safe keeping of rhizobial germplasm that is available by special permission of the donor for distribution or use. To date, one institution and one private company have used this service, but it is anticipated that more will use it in the future.
5. The Center has distributed approximately 400 strains of Rhizobium to over 20 countries in the past 2 years. The requests for strains have increased since the publication of the catalogue.

6. Four researchers: Theresa Fuertes, from Spain; R. Al-Rashidi, from Iraq; Somchai Podiyut, from Thailand; and Dr. Hu from China were given training in Rhizobium methodology by the Center's staff.
7. Contact and assistance to LDC rhizobial workers has been accomplished through correspondence. Further assistance is foreseen as Center personnel travel and become better acquainted internationally.
8. Field evaluation of rhizobial strains has been carried out. Dramatic rhizobia strain X peanut cultivar interactions due to inoculation was demonstrated. Also, field trials on rhizobia for lima bean, mung bean and cowpea were performed, and promising results from the lima bean trial are being pursued further. Tests also are planned for common bean and soybean.

Previous evaluations have indicated problems with personnel and travel ceilings. The temporary full-time slots approved for the project were part of the AR head count which delayed filling slots until well into the contract period. This problem has been alleviated and the slots are now filled with permanent employees, and any additional personnel needed would come from cooperative agreements with the University of Maryland or other cooperating institutions.

The renewal Sept. 1980 agreement with AID transferred travel monies to the Office of International Cooperation and Development (OICD) of USDA. This procedure should adequately take care of future travel needs.

The project is making satisfactory progress. The next management review is scheduled for Oct. 1981.

**PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK**

Life of Project:
From FY _____ to FY _____
Total U.S. Funding _____
Date Prepared: _____

Project Title & Number: World Rhizobium Study- Collection Center

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
<p>Program or Sector Goal: The broader objective to which this project contributes:</p> <p>Program or Sector Goal: The broader objective to which this project contributes:</p> <p>Increase food production and improve quality of life of small farmers through better soil and water management.</p>	<p>Measures of Goal Achievement:</p> <p>Increased food production with reduced dependency on fertilizer nitrogen by increased use of successful, biological nitrogen fixation systems, especially legumes.</p>	<p>Data from world reports on crops and fertilizer nitrogen usage.</p>	<p>Assumptions for achieving goal targets:</p> <p>That biological nitrogen fixation by plant associations, especially legume-rhizobia can lead to increased food production and increased income on family farms.</p>
<p>Project Purpose:</p> <p>To build an international collection of rhizobia that will preserve a broad range of germ plasm with known characteristics from which evaluated cultures can be provided to LDC institutions to promote biological nitrogen fixation, especially by legumes.</p>	<p>Conditions that will indicate purpose has been achieved: End of project status.</p> <ol style="list-style-type: none"> 1. USDA/Beltsville operating an international Rhizobium collection. 2. All Rhizobium cultures catalogued and preserved. 3. Evidence that cultures were provided to others. 4. Trainees complete practical and theoretical training in Rhizobiology research and technology. 	<ol style="list-style-type: none"> 1. Contractor records/reports. 2. On-site inspection; catalogs published. 3. Contractor reports, correspondence. 4. Contractor reports, letter to trainee. 	<p>Assumptions for achieving purpose:</p> <ol style="list-style-type: none"> 1. Cooperation with other Rhizobium Collections. 2. USDA gives priority to maintenance of bacterial germ plasm. 3. Staff given incentives to stay with program. 4. LDC trainees are motivated to make use of "apprenticeship."
<p>Outputs:</p> <ol style="list-style-type: none"> 1. Continue collection of <u>Rhizobium</u> strains. 2. Continue study of the collection. 3. Continue dissemination and exchange of <u>Rhizobium</u> strains. 4. Continue maintenance of collection and service as a depository of rhizobial germ plasm. 5. Initiate trainee program in rhizobial technology. 6. Continue linkages with international and U.S. agencies. 7. Technical publications. 	<p>Magnitude of Outputs:</p> <ol style="list-style-type: none"> 1. Few hundred new cultures added, especially for tropical legumes. 2. Select 6-10 efficient strains for each major legume species. 3. Publish catalogue or supplement every 2 years; (b) by request, a few hundred cultures/yr. 4. Not directly quantifiable. 5. 2-3 each year 6. Int. Agr. Res. Centers, MIRCENS, LDC/s and DC institutions. 7. 10-12 publications over 5 yr. project life. <p>Implementation Target (Type and Quantity)</p> <ol style="list-style-type: none"> 1 AID/W funding at approximately \$150,000 per year. 2. 52 person-months per year including scientists, technical and support laboratory and field research facilities 	<ol style="list-style-type: none"> 1. Review of catalogue and list of uncatalogued new accessions. 2. Contractor reports. 3. Check with recipients, contractor's files on strain requests. 4. Contractor reports, recipient checks. 5. Contractor records & reports, trainee interview. 6. Contractor reports, communication with other agencies. 7. File of contractor's publications. 	<p>Assumptions for achieving outputs:</p> <ol style="list-style-type: none"> 1. Cultures will continue to be exchanged with other institutions - laboratories and new germ plasm will continue to be gathered. 2. Ag. scientists in LDC's will use rhizobial cultures.
<p>Inputs:</p> <ol style="list-style-type: none"> 1. AID/W provides financial support and project guidance 2. Contractor provides qualified personnel and major facilities. 		<ol style="list-style-type: none"> 1. AID/W records 2. Contractor reports 3. Reports, on-site verification. 	<p>Assumptions for providing inputs:</p> <ol style="list-style-type: none"> 1. Appropriate AID/W funding will be available. 2. Contractor has adequate personnel and facilities available to project and will cooperate with other culture collections. 3. Cooperation provided by (1) other culture collections 2) Int. Centers Universities, LDC's/g

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PROGRAM: CENTRALLY FUNDED

TITLE World Rhizobium Collection Center NUMBER 931-0095 Grant (X) Loan ()		FUNDS Agriculture, Rural Dev. & Nutrition PRIOR REFERENCE	Project Manager: L.R. Frederick Proposed Obligation FY 1981 \$150 FY 81 Oblig. Auth. by PI \$0	Proposed Life of Project \$975 Life of Project per App. PP \$525	Init. Oblig. FY 79	Proposed Est. Final Oblig. FY 1982 Final Obligation per PP FY 1978	Proposed Completion Date FY 1983 Completion Date per PP FY 1979
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Attachment A

Date of last Intensive Evaluation: 8/23/78

PURPOSE: Maintain and preserve rhizobia strain collection; evaluate cultures; collect new germplasm; distribute requested strains to researchers worldwide; AID support for tropical and exotic rhizobia.

BACKGROUND AND PROGRESS TO DATE: USDA has been building rhizobia collection for more than 50 years. AID support is to make collection worldwide in scope, especially for tropical legumes. Progress to date includes:

1. Collection continues to increase; some inputs from field trips from non-AID sources.
2. Evaluation by greenhouse and field testing is ongoing.
3. New laboratory facilities completed. New staff scientist hired.
4. Stronger linkages with other institutions and collections.
5. Distribution of 450 strains to researchers worldwide per year.
6. Training of LDC scientist initiated.

HOST COUNTRY AND OTHER DONORS: N/A for host countries, but USDA contributes about 20,000 per year.

BENEFICIARIES: Tropical biological nitrogen fixation researchers worldwide (LDCs and LDCs alike) for ultimate benefit of small farmers in LDCs.

FY1981 PROGRAM: To continue maintenance of collection, improvement and evaluation of worldwide rhizobia collection, testing, distribution of strains, and training of LDC scientists.

MAJOR OUTPUTS:

Thru FY1979
and

Cumulative life of Project

1. Collection of Rhizobium cultures
2. Study of the collection
3. Dissemination and exchange of rhizobia
4. Maintenance of collection
5. Linkages with international and U.S. agencies

A.I.D. FINANCED INPUTS:

	FY81 \$000
Salaries	60
Travel	15
Training	20
Operations	55
	\$150

TECHNICAL OFFICE SUPPORT (in person months):

FY	DI	IPA	Consult.	RSSA	Total
1979	0.25	-	0.25	-	0.5
1980	0.25	-	0.25	-	0.5
1981	0.25	-	0.25	-	0.5

	Obligations (\$000)	Expenditures (\$000)	Unliquidated (\$000)	Funding Period	Principal Contractors or Agencies & Contract Number
Through September 30, 1978	525	417	102	XXXXXXXXXXXXXXXXXXXX	USDA/SEA/AR - U.S. Dept. of Agriculture/Science and Education Administration/Agricultural Research (RSSA-USIA 4-76)
Estimated FY 1979	0	50	102	Prior funds to 6/30/80	
Estimated through FY 1979	525	467	XXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXX	
Proposed FY 1980	150	98	XXXXXXXXXXXXXXXXXXXX	6/30/80 to 6/30/81	
Estimated through FY 1980	675	565	110	XXXXXXXXXXXXXXXXXXXX	
Proposed FY 1981	150	150	975	6/30/81 to 6/30/82	
Future Yr. obligation			Estimated Total Cost		

5435

TITLE Biological Nitrogen Fixation		SECTOR Agriculture, Rural Development and Nutrition	PROPOSED OBLIGATION (in thousands of dollars) FY 80 1,150		LIFE OF PROJECT 508
NUMBER 931-A053	NEW <input type="checkbox"/> CONTINUING <input checked="" type="checkbox"/>	PRIOR REFERENCE FY 1979 Annex A Centrally Funded p. 934	INITIAL OBLIGATION FY 75	ESTIMATED FINAL OBLIGATION FY 85	ESTIMATED COMPLETION DATE OF PROJECT FY 85

Purpose: To develop ways to enable tropical crops to capture nitrogen from the air.

Background and Progress to Date: The high prices of fossil fuels have created a long-term need for economic alternatives to expensive, chemically-produced nitrogen fertilizer. A potential alternative is nature's process of biological nitrogen fixation (BNF). The LDC small farmer urgently needs an efficient technology based on this process. In temperate zones, past reliance on nitrogen fertilizers has resulted in little BNF research, few persons trained, and stagnation in practical technology; even less was done in the tropical LDCs. Current BNF temperate zone technology must first be specially adapted to the tropics. New knowledge and technologies for tropical BNF are also required.

In 1975 A.I.D. started a long-term program to develop tropical BNF as a major component of LDC farming. The first phase is mobilizing scientists to develop a reliable tropical BNF technology. Phase II is testing this technology by cooperative field trials with LDC scientists. Phase III will develop country-specific BNF systems for small farmers.

Tropical grain legumes, such as cowpeas and soybeans, which constitute 10% of the food grown in LDCs, have the unique capacity to obtain most of their nitrogen through bacteria living in their root nodules. Unfortunately this capacity is very low. Research is being conducted to raise this capacity and hopefully will provide an efficient BNF technology in the near future.

Grasses, such as corn, sorghum and leucaena grass are major LDC food items for both man and animal. Recent evidence indicates that bacteria can be stimulated to fix nitrogen in association with the roots of some grasses. This possibility is being investigated and could produce spectacular dividends, although not in the near future.

To support on-going and future research and development worldwide a germ plasm bank and information center for tropical BNF is being established at the U.S. Department of Agriculture.

Host Country and Other Donors: Australia, France, and the United Kingdom provide trained personnel and research results. FAO is starting a similar program that relies heavily on past and ongoing BNF work of A.I.D. and complements our program. Four International Agricultural Research Centers are also conducting related research.

Beneficiaries: Immediate beneficiaries are tropical BNF scientists in both rich and poor countries. Intermediate beneficiaries are agriculture development officers in the LDCs. Ultimate beneficiaries are the LDC small farmers.

FY 80 Program: The following activities will be funded (\$ thousands): Symbiotic Nitrogen Fixation by Tropical Legumes (\$800), World Rhizobium Collection Center (\$150) and Comparative BNF Economic Evaluation (\$200). With these funds research on tropical BNF will continue and support will be provided to the germ plasm bank and information center.

Major Outputs: Efficient BNF technology for tropical legumes; new and improved BNF support technologies; crop systems that increase BNF; trained BNF scientists and agricultural workers in LDCs, international resource center; determination of the potentials of BNF by grasses.

A.I.D. Financed Inputs:

	(\$ thousands)
R&D Grants and Contracts	FY 80 1,150
Total	1,150

U.S. FINANCING (in thousands of dollars)

	Obligations	Expenditures	Unliquidated
Through September 30, 1978	5,139	3,608	1,531
Estimated Fiscal Year 1979	1,825	1,846	
Estimated through September 30, 1979	6,964	5,454	1,510
Proposed Fiscal Year 1980	1,150	2,394	Estimated Total Cost 10,508

PRINCIPAL CONTRACTORS OR AGENCIES

Universities: Hawaii, Cornell, Puerto Rico, North Carolina State and Florida. U.S. Department of Agriculture/Science and Education Administration. Federal Research (FP) and Cooperative Research (CR). National Academy of Sciences.

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PROJECT REVIEW SUMMARY

PROJECT TITLE: World Rhizobium Collection and
Study Center

DATE OF
REVIEW 8 FEB 80

PROJECT NO. 931-0095

OSB OFFICE/DIV. AGR/TSWM

List actions to be taken (or issues to be resolved) as a result of Project Review Meeting	Action Officer	Date Action to be Complete
1. Staff position of Dr. Harold Keyser must be assured.	USDA-Schaefer/ Finney/Putnam	2/80
2. Proposal to extend RSSA	USDA - Weber	3/80
3. PP prepared and approved	L. Frederick	5/1/80
4. Action memorandum to DAA/DS/FN requesting approval to extend project through 6/30/85.	L. Frederick	5/15/80
5. PIO/T	L. Frederick	5/30/80
6. Extension of RSSA	SER/CM	6/30/80
7. Regular evaluation	L. Frederick	3/81

Lloyd R. Frederick

Project Manager

Lloyd R. Frederick

DS/AGR:MMyozynski

Attachments: OSB Project Data Sheet
Project Review Information Sheet
Others:

Keith Byergo

Office Director

Distribution: Project Files

DS/DAA
DS/PO: Program Analyst

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PROJECT REVIEW INFORMATION

PROJECT TITLE World Rhizobium Collection and Study Center DATE OF REVIEW 2/8/80
PROJECT NO. 931-0095

I. Briefly state principal subject(s) to be discussed during the review.
USDA staffing problems-^{assurance} of Dr. Keyser's services, technical support- due to ceilings and personnel errors. Catalog of Rhizobial strains, training plans for overseas scientists, strain evaluations, publications; exchange of culture with other labs. Extension of RSSA for 5 years - level funding indicating reduction of AID support as inflation takes its toll. Travel problems - USDA staff need to make more contacts, but travel ceilings have interfered.

II. Please respond to the following questions. Additional detail can be given below if warranted or necessary.

- a. Is project implementation on schedule as planned in the PP or implementation plan? Behind schedule but satisfactory
- b. Are there any short falls or delays of project inputs? Yes, but are handled satisfactory
- c. Are project assumptions holding up? yes
- d. Are progress/annual reports being submitted in a timely fashion? satisfactory but delayed
Are such reports informative? yes
- e. Is there any monitoring/progress information being received from other than project or contractor personnel (e.g., project manager site visits, USAID reports etc.)? Yes, project manager makes site visits every 3 to 6 months due to proximity.
- f. Has an evaluation been carried out? Yes - Team 8/78, PES 10/78
- g. Are there any audit or evaluation recommendations outstanding? No
- h. Are there any special or restrictive requirements imposed by RAC or stipulated in the PP? No.

Attachment: ABS Project Data Sheet

PROGRAM: CENTRALLY FUNDED

Project Manager: L.R. Frederick

Attachment A

TITLE World Rhizobium Collection Center	FUNDS Agriculture, Rural Dev. & Nutrition	Proposed Obligation FY 1981 \$150	Proposed Life of Project Cost \$975	Init. Oblig. FY	Proposed Est. Final Oblig. FY 1982	Proposed Completion Date FY 1983
NUMBER 931-0095	PRIOR REFERENCE	FY 81 Oblig. Auth. by PP \$0	Life of Project per App. PP \$525	TQ	Final Obligation per PP FY 1978	Completion Date per PP FY 1979
Grant <input checked="" type="checkbox"/> Loan <input type="checkbox"/> New <input type="checkbox"/> Continuing <input checked="" type="checkbox"/>		Date of Last Intensive Evaluation: 8/23/78				

PURPOSE: Maintain and preserve rhizobia strain collection; evaluate cultures; collect new genoplasm; distribute requested strains to researchers worldwide; AID support for tropical and exotic rhizobia.

BACKGROUND AND PROGRESS TO DATE: USDA has been building rhizobia collection for more than 50 years. AID support is to make collection worldwide in scope, especially for tropical legumes. Progress to date includes:

1. Collection continues to increase; some inputs from field trips from non-AID sources.
2. Evaluation by greenhouse and field testing is ongoing.
3. New laboratory facilities completed. New staff scientist hired.
4. Stronger linkages with other institutions and collections.
5. Distribution of 450 strains to researchers worldwide per year.
6. Training of LDC scientist initiated.

MAJOR OUTPUTS:

Thru FY1979 and

Cumulative Life of Project

1. Collection of Rhizobium cultures
2. Study of the collection
3. Dissemination and exchange of rhizobia
4. Maintenance of collection
5. Linkages with international and U.S. agencies

A.I.D. FINANCED INPUTS:

	FY81
	\$000
Salaries	60
Travel	15
Training	20
Operations	55
	\$150

TECHNICAL OFFICE SUPPORT (in person months):

FY	DH	IPA	Consult.	RSSA	Total
1979	0.25	-	0.25	-	0.5
1980	0.25	-	0.25	-	0.5
1981	0.25	-	0.25	-	0.5

HOST COUNTRY AND OTHER DONORS: N/A for host countries, but USDA contributes about 20,000 per year.

BENEFICIARIES: Tropical biological nitrogen fixation researchers worldwide (DCs and LDCs alike) for ultimate benefit of small farmers in LDCs.

FY1981 PROGRAM: To continue maintenance of collection, improvement and evaluation of worldwide rhizobia collection, testing, distribution of strains, and training of LDC scientists.

	Obligations (\$000)	Expenditures (\$000)	Unliquidated (\$000)	Funding Period	Principal Contractors or Agencies & Contract Number
Through September 30, 1978	525	417	108		
Estimated FY 1979	0	50	58	XXXXXXXXXXXXXXXXXXXX	
Estimated Through FY 1979	525	467	166	Prior funds to 6/30/80	80
Proposed FY 1980	150	98	52	XXXXXXXXXXXXXXXXXXXX	USDA/SEA/AR - U.S. Dept. of Agriculture/Science and Education Administration/Agricultural Research (RSSA-USDA 4-76)
Estimated Through FY 1980	675	565	218	6/30/80 to 6/30/81	
Proposed FY 1981	150	150	110	XXXXXXXXXXXXXXXXXXXX	
		Future Yr. Obligation	110	6/30/81 to 6/30/82	
			Estimated Total Cost		
			975		