CLASSIFICATION

PROJECT EVALUATION SUMMARY (PES) — PART I

Report Symbol [illegible]

1. PROJECT TITLE	2. PROJECT NUMBER	3. MISSION/AID/W OFFICE
N-Fixation Problems and Limiting Factors	931-0610	S&T/AGR/RNR

4. EVALUATION NUMBER (Enter the number maintained by the reporting unit e.g., Country or AID/W Administrative Code, Fiscal Year, Serial No. beginning with No. 1 each FY) 22-5
(In depth Team Evaluation)
☒ REGULAR EVALUATION ☐ SPECIAL EVALUATION

5. KEY PROJECT IMPLEMENTATION DATES			6. ESTIMATED PROJECT FUNDING (From FY 76 to 86)	7. PERIOD COVERED BY EVALUATION
A. First PRO-AG or Equivalent FY 76	B. Final Obligation Expected FY 86	C. Final Input Delivery FY 87	A. Total $6,050,000 B. U.S. $6,050,000	From (month/yr.) November 1978 To (month/yr.) June 1981 Date of Evaluation Review June 30, 1981

8. ACTION DECISIONS APPROVED BY MISSION OR AID/W OFFICE DIRECTOR

A. List decisions and/or unresolved issues; cite those items needing further study. (NOTE. Mission decisions which anticipate AID/W or regional office action should specify type of document, e.g., airgram, SPAR, PIO, which will present detailed request.)	B. NAME OF OFFICER RESPONSIBLE FOR ACTION	C. DATE ACTION TO BE COMPLETED
1. With additional funding, extend the PASA through April 30, 1983.	L. Frederick AID/ST/AGR	4/15/82
2. Prepare proposal for project extension for 5 years.	R. Miller USDA/CSRS	4/15/82
3. Evaluation of proposal and decide on further work in this area of work.	L. Frederick, AID/ST/AGR Review Committees J.S.Robins AID/ST/FA	11/82
4. If decision in 3 is positive, with additional funding, extend PASA for 5 years.	L. Frederick AID/ST/AGR	2/83

9. INVENTORY OF DOCUMENTS TO BE REVISED PER ABOVE DECISIONS

- [XX] Project Paper
- [XX] Financial Plan
- [XX] Logical Framework
- [XX] Project Agreement
- [ ] Implementation Plan e.g., CPI Network
- [XX] PIO/T
- [ ] PIO/C
- [ ] PIO/P
- [ ] Other (Specify)
- [ ] Other (Specify)

10. ALTERNATIVE DECISIONS ON FUTURE OF PROJECT

- A. [XX] Continue Project Without major Change for five year extension.
- B. [ ] Change Project Design and/or
- [ ] Change Implementation Plan
- C. [ ] Discontinue Project

11. PROJECT OFFICER AND HOST COUNTRY OR OTHER RANKING PARTICIPANTS AS APPROPRIATE (Names and Titles)

S&T/AGR/RNR/L.Frederick [signature] date 1/19/82
S&T/AGR/RNR/[illegible] [signature] date 2/3/82
S&T/AGR/M.Mosynski [signature] date 2/8/82
S&T/AGR/[illegible] Walker date
S&T/AGR/D.Fiester date S&T/PO [illegible]

12. Mission/AID/W Office Director Approval

Signature [signature]
Typed Name AD/FA/S&T/J.S.Robins
Date 2/15/82

AID 1330-[illegible]

PES: N-FIXATION, LIMITING FACTORS - 931-0610 6/81

13. SUMMARY:

Nitrogen deficiency in crops is a major limiting factor in food production. Current and anticipated costs of fertilizer nitrogen limit its use. Economic use of biological nitrogen fixation (BNF) as an alternative demands a reliable BNF technology.

Research under this limiting factor program addresses the problems of quality inoculants and inoculation technology, other limiting factors to inoculation, nitrogen fixing efficiency in both crop and nodule bacteria, and general crop production. Results provide information expected to enable farmers to effectively use this low cost nitrogen delivery system. This program in a most complex research area is only six years old and is beginning to provide significant results capable of use in LDCs to increase legume production.

To date, 41 sub-grants for three year projects have been awarded to 21 U. S. universities, with 34 principal investigators and a comparable number of graduate students (many from LDCs). At least 23 scientists from LDCs have been supported for collaborative work in 16 of the 41 sub-grants. A coordinating meeting is held annually. In 1981, a workshop was held at CIAT with 190 participants to provide an assessment of the use of BNF technology in the tropics and to promote technology transfer.

The unusual mechanism of this project (to fund a PASA with USDA/CSRS which in turn makes sub-grants to U.S. institutions) is a sound one. Careful consideration by a Selection Committee is given to the scientific quality of the proposals for sub-grants as well as to the likelihood of its contribution to LDC problems. The arrangement is cost-effective and draws on a broad base of scientific expertise that would not otherwise have been available.

Research areas have included: survival of root nodule bacteria in inoculants, improved inoculants, conditions for handling and storage of inoculants, methods of using inoculants, selection of rhizobial strains adapted to host, soil acidity, temperature, moisture stress, pesticides, fertilizers, other microbes and plant roots, selection to improve BNF genetic capability of plant, effects of chemical nutrient deficiencies, plant pests and chemical toxicities, as well as Rhizobium - host interactions with many of the above factors.

Progress has been highly satisfactory with research results documented in 21 refereed journal articles, in 32 reports at workshops, national and international meetings, and 8 theses for M.S. or Ph.D. degrees.

Much research remains to be done, but the research done so far has improved several techniques, identified alternate carriers that have potential as a substitute for peat, proved that improved BNF effectiveness can be bred into legumes, identified breeding lines of cowpeas and beans for increased nitrogen fixation and tolerances to several soil and environmental stresses (salt, Mn and Al). In-country studies have identified nutrient limitations on BNF in Nigeria, Panama and Egypt, and inadequate nodulation in Morocco, Senegal, Mexico, Egypt, Nigeria, Sudan, Chile, El Salvador and Brazil.

13. SUMMARY (continued)

The program should be continued for another five-year period. The review process should continue to use both peer reviews and the judgment of the Selection Committee. Participating scientists should meet together on a regular basis. Staff from AID or USDA should visit the active institutions on an annual basis.

Future announcements for proposals should include a list of criteria used to evaluate the suitability of each submission. AID should implement a "Tropical Legume Inoculant Service" project to promote BNF technology transfer; continue the present grant procedures in which the U.S. universities are given major responsibility for administering and accounting for funds used both at the institution and overseas in cooperative work.

Future requests for research should continue the present problem areas and consider expansion to include more work on forage legumes, work on non-leguminous trees in LDCs, Azolla and blue-green algae. Future funding levels should maintain the present level of program activity. Training of LDC scientists under this program should continue with priority given to scientists from countries not previously represented.

14. EVALUATION METHODOLOGY: See Team report, pages 7 and 8.

15. EXTERNAL FACTORS: No major changes.

16. INPUTS: See team report, pages 15 to 18.

17. OUTPUTS: See team report, pages 13 and 14.

18. PURPOSE: See team report, pages 4, 5 and 6.

19. GOAL/SUBGOAL: See team report, pages 4, 5 and 6.

20. BENEFICIARIES: See team report, page 9.

21. UNPLANNED EFFECTS: See team report, page 6.

22. LESSONS LEARNED: See team report, pages 15 - 18.

23. SPECIAL COMMENTS:

Attachments: A. Report of Review Team Evaluation of Biological Nitrogen Fixation Limiting Factors Project, June 30, 1981.

B. Scope of Work - Team Project Evaluation.

C. FY83 ABS Activity Data Sheet.

D. Project Design Summary Logical Framework.

Attachment A

PD-AAS-513

XD AAS 512-A

93106.0/17

REPORT OF REVIEW TEAM EVALUATION

OF

BIOLOGICAL NITROGEN FIXATION LIMITING FACTORS PROJECT

ADMINISTERED BY USDA/SEA/CR

AND

FUNDED BY AID/DSB/AGR

JUNE 30, 1981

INTRODUCTION

Biological nitrogen fixation (BNF) has been exploited in agriculture for more than 6000 years even though the process is not completely known. What is known is that nitrogen deficiency in crops is a major limiting factor in food production. Before the high cost of energy resulting from high oil and gas prices, much of the nitrogen for crop production was supplied by commercial fertilizers. Now the cost of nitrogen fertilizer prohibits its use to many crops including legumes which formerly used nitrogen fertilizer to increase production.

The legumes and other plant associations are able to obtain dinitrogen from the air by biological nitrogen fixation. In the case of legumes, nodules are formed on the roots and it is within this structure that the plant association (symbiosis) utilizes the dinitrogen from the soil air and converts it to a form the plant can use.

The process is exploited widely in temperate countries and a whole industry has endured around BNF. In tropical and subtropical LDC's, this process has not been exploited as readily and incorporated into their agriculture because of lack of technology and lack of people trained in BNF technology. A particular technology package that has not been exploited in LDC's has been with inoculants. Over the years a number of techniques have been used for inoculating legumes with selected rhizobia. These have

usually been packaged in a peat based carrier. In LDC's, the quality of the inoculant has for the most part been poor and inoculation success minimal.

In many of the LDC's little information exists on producing quality inoculants and the inoculant technology has not been exploited to increase production. Research being performed under this limiting factor program addresses this particular problem and other limiting factors to inoculation, nitrogen fixing efficiency and general crop production. It is expected to provide an information base which will eventually enable the small land-holder in the LDC's to effectively utilize this low cost nitrogen delivery system.

HISTORY OF PROGRAM

Initial reference should be made to project number 931-0610 entitled "Team Project Evaluation" for details of the review dated June 29-30, 1981.

This BNF Limiting Factor program in a most complex research area is only six years old and it is just beginning to provide significant results capable of transfer to the LDC's in support of legume (food, forages, trees) production in the absence of fertilizer nitrogen. It was initiated in April of 1976 by contract with USDA/SEA/CR and utilizing the sub-grant approach.

To date, forty-one sub-grants for three-year projects have been awarded to twenty one U.S. universities, with thirty-four principal investigators and a comparable number of graduate students (many from LDC's). Because a priority was given in the second three-year phase of the project to emphasize collaboration between the U.S. scientists and LDC's, sixteen projects with at least twenty-three scientists from LDC countries have been funded.

Meetings with the participating scientists are held at scientific meetings and in 1981, a workshop was held at CIAT in Colombia, with 190 participants including all of the above-cited investigators, to provide an assessment of BNF technology and to reinforce linkages with the LDC's for eventual assistance in technology transfer.

The original purpose of the grant was to involve the BNF researchers in U.S. universities in a program essential to the well being of people in the LDC's (a US-AID objective), to assess the state of the art and elaborate research needs to train scientists particularly from the LDC's to do BNF work because present capabilities are insufficient, and to institute an applied field-oriented research program essential to the adoption of legume-important methodologies in the LDC's.

INVOLVEMENT OF LDC'S

Prior to 1977, the BNF program emphasis was placed on U.S. university based research and was appropriate at that time since the project was in the technology development stage. However, since 1977, there has been an increasing involvement of cooperating scientists in LDC's/MDC's. Since the inception of this project, there have been 41 proposals funded. Since the first LDC cooperative involvement in 1977, there have been 28 grants to U.S. institutions, of which 17 LDC's have been involved in projects. This does not include International Agriculture Research Centers (IARC's), which are encouraged to be cooperative in BNF work but do not receive any of the BNF project funds.

Presently there have been at least 23 LDC scientists cooperating with U.S. scientists in these grant activities. The BNF interest generated by these grants has stimulated an increase in the number of LDC graduate students trained in soil microbiology and other plant sciences. These trained graduate students return to the LDC's and continue to provide linkages for U.S. Scientists. They also add to the scientific manpower base of the LDC's that is so important to all types of agricultural development. Since 1978 there have been more than 30 LDC graduate students who have undergone training in the U.S. and/or in host or third world countries. These students have helped conduct research either in

the U.S. or LDC's and presented papers and published documents on their research.

An additional benefit to the BNF research in LDC's is the involvement of new/young U.S. scientists. This project provides an opportunity for these young researchers to add to the U.S. resource base people who are aware of LDC problems in agricultural development and establishing contacts/linkages in LDC's that will more than likely continue beyond the end of the project and throughout their careers.

There have been some unexpected results occuring from the research programs. Although the research work on inoculation was not successful, some of the alfalfa varieties taken to the one LDC as part of an experiment proved to be more productive than any varieties that were currently available in the country. A local farmer realized this and was growing and selling the seed to other farmers before the end of the three-year project.

Prior to this project, more than 90% of the BNF work in the U.S. was on soybeans, but now more than 30% of the BNF research is on crops other than soybeans.

PROCESSES AND PROCEDURES OF THE PROGRAM

The evaluation team was requested to assess the progress of the project and to make a definite recommendation regarding future funding. The study team consisted of Dr. Frederick Hutchinson, University of Maine, Chairman, Dr. William P. Martin, University of Minnesota, Dr. Earl R. Swanson, University of Illinois, Dr. W. Phillip Warren, AID/LAC/DR/RD, and Dr. Deane Weber, USDA/ARS. Others participating in the review included: Dr. Lloyd R. Frederick, DS/AGR, Project Manager, Dr. Robert H. Miller, USDA/CSRS and Ohio State University Program Director, Ms. Rebecca Burt, AID/LAC/DR/RD, and Dr. Charles M. Smith, USDA/CSRS.

The study team was furnished the following documents for review prior to the meeting on June 29-30, 1981:

1. PASA between AID and USDA
2. Research Project Statement
3. Summary of Activities and CRIS Reports for Sub-grants for 1980
4. Project Officers' Project Review Summary - February, 1980
5. Team Project Evaluation Summary and Report - October, 1978
6. Samples of 1979 Narrative Reports

During the first day of the meeting (June 29), the Program Director, Dr. Robert Miller and the Project Manager, Dr. Lloyd Frederick, made oral presentations of the history and present

status of the project. Plans for future activities were presented on June 30. Adequate opportunity was given team members to raise questions and for the Program Director and Project Manager to respond. In general, the scope of the team's evaluation included an assessment of accomplishments by the scientists receiving subgrants, as well as matters of organization and administration of the project. The specific problems and issues to be addressed by the team are presented in the document "Team Project Evaluation, Scope of Work" (p. 3). The cost of the evaluation was approximately $ 1,310 . for travel and per diem. The services by the eight scientists who participated were contributed by their own institutions.

BENEFICIARIES OF THE PROGRAM

The ultimate beneficiaries of the BNF technology will be the farmers and the general population of the LDC's in which the technology is adopted. Because the technology is relatively simple in terms of the ease with which it can be integrated into a crop management system, it is expected that small farmers as well as larger ones who have more sophisticated management skills, will be able to adopt the BNF technology. In general, the cost of the inoculant should be sufficiently low to induce adoption, even though the results may be viewed by the farmer as being somewhat uncertain. That is, the cost of taking a chance with a new technology is not very high. Further, the BNF technology is consistent with the maintenance of a labor-intensive agriculture. Small amounts of added labor will be required during application of the inoculant and to harvest the increased yield. The lag in adoption by small farmers, as compared to larger ones, should be short, thus minimizing any adverse income distribution impacts. Insofar as the BNF technology is used on food crops consumed directly by members of the farm household, it is likely to benefit small farmers relatively more than larger ones.

EVALUATION OF PROGRAM

a. Administration

The basic concept of providing a grant to the USDA/SEA/CR with sub-grant to U.S. institutions is a sound one. This administrative arrangement has been successful in attracting the participation of a large number of those U.S. soil microbiologists specializing in applied research on BNF. In addition, a few other qualified scientists from related areas have participated, as well as some who previously had only basic research interests. This wide-spread participation is due, in part, to the utilization of USDA research administration. However, additional factors have been involved. The working relationships between the AID Project Manager and the USDA Program Directors appear to be excellent. The evidence available to the team also indicated that effective relationships have developed with scientists at the U.S. institutions receiving sub-grants. One attractive feature of the project is the diversity that is permitted in the form of important relationships needed between the U.S. scientist and, those in the LDC's. For example, this may be a very informal relationship via a graduate student and his thesis research or it may be a part of a more formal institution-to-institution relationship. However, some evidence of a collaborative relationship with an LDC is necessary prior to the award of a sub-grant.

An examination of the procedures for review of sub-grant proposals indicates that careful consideration is given to the scientific quality of the proposal as well as to the likelihood of its contribution to LDC problems. Heavy reliance is placed on peer review in evaluation of the scientific quality of proposals. One desirable feature of the procedure is the submission of a brief pre-proposal document. The staff may then provide the investigator with guidance prior to development and submission of a more complete proposal.

In comparison with alternative forms of administering this research project, we judge the arrangement to be cost-effective. The project draws on the long-established research administrative capability of the USDA. Further, the basic concept of small grants has permitted an added dimension to a large number of high quality domestically-oriented BNF programs at U.S. institutions. This has enhanced the cost-effectiveness of the project by drawing on a broad base of scientific expertise that would not otherwise have been available.

The present suggestions for the preparation of proposals indicates that the scientist should identify a problem on which a contribution could be made and a developing country where the problem limits biological nitrogen fixation. Consideration should be given from time to time to somewhat more guidance to prospective

applicants indicating the importance of project objectives which need more emphasis. This may be accomplished in comments on pre-proposal submissions and/or in the announcement of the availability of sub-grants.

b. Scientific Productivity

The USDA/SEA/CR/AID Biological Fixation Program has been operational for slightly over five years. Problem areas of BNF identified and projects addressing these problems are as follows:

A. Factors limiting quality of inoculant and inoculation success.

B. Factors in the soil that limit successful biological nitrogen fixation.

C. Factors in the plant that limit nodulation and BNF.

D. Rhizobium-host interactions.

Research areas under "A" are: Survival of root nodule bacteria in the inoculant, improved methods of producing inoculant, improved methods of formulating inoculants, conditions for handling and storage of inoculant and methods of using inoculant adapted to farmers' needs in the tropics and sub-tropics. Research areas under "B" are: Rhizobial strains adapted to the soil, soil temperature and soil moisture, acidity and nutrient content of soil, antagonistic effects of plant roots, other microbes and pesticides and fertilizers. Research areas under "C" are: BNF genetic capability of the plant, deficiencies of chemical nutrient elements, production potential of plants, plant parasites and diseases and toxicities of chemical elements. Research areas under "D" are: Rhizobium-host interactions.

Progress has been highly satisfactory with the research results documented in 21 refereed journals, presented as talks at 32

workshops, national and international meetings, and as eight M.S. and Ph.D. theses and dissertations. Final solutions to the problems identified as limiting crop production have not been attained because of the complexity of the problems. However, the research has identified several research techniques, identified and improved substitute inoculant carriers and inoculation techniques, identified breeding lines of cowpeas and beans for increased nitrogen fixation efficiency and tolerances to several soil and environmental stresses (salt, Mn and Al). Further studies have identified nutrient effects on BNF in Nigeria, Panama, and Egypt and determined whether nodulation is a limiting factor in Morocco, Senegal, Mexico, Egypt, Nigeria, Sudan, Chile, El Salvador and Brazil.

FUTURE DIRECTIONS FOR THE BNF LIMITING FACTORS PROGRAM

The strategy for this program was originally conceived in 1975. It has been extremely successful in mobilizing U.S. scientists to link with LDC scientists in studying applied aspects of BNF for legumes, excluding soybeans, and also certain forage and tree legumes. Now it is imperative the program be appropriately structured and focused to assure continued progress in the future.

The Review Team has found the program to be very worthwhile. It suggests the following points for future consideration:

1. The program should be continued for another five-year period beyond April, 1982. The Team recognizes that BNF research is by its nature long term and that a commitment for at least ten years is essential. The five year extension assumes another review at that time.

2. The peer review process used in the past three years of the program should be continued because it allows an essential element of judgement by the Selection Committee.

3. The administrators of the program should continue to call the participating scientists together on a regular basis to inform them of the total dimension of the program, and to encourage coordination of Rhizobia strains and host plant cultivars to be utilized as standards in the various experiments. (This would assume comparability of research results without forcing all

scientists to use exactly the same variables). The Workshop being planned for early 1982 is commendable. It should focus primarily upon the following points:

A. Identify from the research already done and from the literature those Rhizobium strains which are best suited to enhance BNF within all the major edible, forage and tree legumes.

B. Identify from research field testing and from the literature, those cultivars of edible food legumes best suited for certain soil and climatic conditions.

C. Discussion and evaluation of experiences which would lead to recommendations to improve cooperative BNF research in LDC countries.

4. A representative of USDA or AID should attempt to visit each of the U.S. institutions active in the BNF program on an annual basis and the LDC sites whenever possible.

5. In the future, the letter sent out to U.S. Scientists for participation in the program should include a list of the criteria used to evaluate the suitability of each submission.

6. Although it is not the intent of this program to develop transfer of BNF technology, it is important that the project entitled "Tropical Legume Inoculant Service"within AID/DSB/AGR be activated. The latter project will assure that new technology developed by the BNF Limiting Factors Program will be introduced into packages of BNF technology available to farmers in LDC's.

7. The Review Team finds the procedure used in the BNF program by which participating U.S. universities are given major responsibility for administering and accounting for the funds granted to them to be an excellent example of how universities and USDA-AID can best work together to accomplish a common goal. This should be continued in the future.

8. There are several areas in which the BNF Limiting Factors Program should be expanded in the future. These are as follow:

- Forage Legumes

Even though the number of U.S. scientists working on BNF related to forage legumes is small, the importance of this topic to future livestock production in LDC's demands that it receive more attention. The present program has heightened the interest of U.S. and LDC scientists and the record to date indicates they would be responsive to an enlarged program.

- Non-leguminous Trees

In addition to leguminous trees, there are some trees available for production in LDC's which are capable of nodulation and subsequent N fixation. The critical importance of fuelwood in many countries warrants some study in this program of these species and their BNF capability.

- Azolla Blue-Green Algae

It has been recognized in recent years that Azolla culture and N-fixation by blue-green algae may be significant and useful in LDC's. Project support for this area of research

should be given serious consideration during the next five-year grant period.

9. The Review Team suggests this Program should not include the area of associative N-fixation by grasses because the topic has not been developed to the point that it lends itself to adaptive research in the field under LDC conditions. The Team is aware AID is funding research on this topic under another component of its total BNF program.

10. Future funding levels should be adequate to, at the minimum, maintain the present level of program activity, with necessary funds for inflation included. The history of the program shows that there have been many more sound research proposals each year than were possible within budget limitations (only 20 percent of proposals have been funded).

11. The BNF program has accomplished the training of a number of LDC scientists to date. It is important the administrators of the program conduct a review to determine which LDC's have not been represented in this or other BNF training programs and take appropriate steps to encourage their inclusion in the future.

RECOMMENDATIONS OF THE REVIEW TEAM

REGARDING THE

BIOLOGICAL NITROGEN FIXATION LIMITING FACTORS PROGRAM

1. The program should be continued for another five-year period beyond April, 1982. The Team recognizes that BNF research is by its nature long term and that a commitment for at least ten years is essential. The five year extension assumes another review at that time.

2. The peer review process used in the past three years of the program should be continued because it allows an essential element of judgement by the Selection Committee.

3. The administrators of the program should continue to call the participating scientists together on a regular basis to inform them of the total dimension of the program, and to encourage coordination of Rhizobia strains and host plant cultivars to be utilized as standares in the various experiments. (This would assume comparability of research results without forcing all scientists to use exactly the same variables). The Workshop being planned for early 1982 is commendable. It should focus primarily upon the following points:

   A. Identify from the research already done and from the literature those Rhizobium strains which are best suited to enhance BNF within all the major edible, forage and tree legumes.

   B. Identify from research field testing and from the literature, those cultivars of edible food legumes best suited for certain soil and climatic conditions.

   C. Discussion and evaluation of experiences which would lead to recommendations to improve cooperative BNF research in LDC countries.

4. A representative of USDA or AID should attempt to visit each of the U.S. institutions active in the BNF program on an annual basis and the LDC sites whenever possible.

5. In the future, the letter sent out to U.S. scientists for participation in the program should include a list of the criteria used to evaluate the suitability of each submission.

6. Although it is not the intent of this program to develop transfer of BNF technology, it is important that the project entitled "Tropical Legume Inoculant Service" within AID/DSB/AGR be activated. The latter project will assure that new technology developed by the BNF Limiting Factors Program will be introduced into packages of BNF technology available to farmers in LDC's.

7. There are several areas in which the BNF Limiting Factors Program should be expanded in the future. They are:

   A. Forage Legumes

   B. Non-leguminous Trees

   C. Azolla - blue-green Algae

8. The Review Team suggests this program should not include the area of associative N-fixation by grasses because the topic has not been developed to the point that it lends itself to adaptive research in the field under LDC conditions. The Team is aware AID is funding research on this topic under another component of its total BNF program.

9. Future funding levels should be adequate to, at the minimum, maintain the present level of program activity, with necessary funds for inflation included. The history of the program shows that there have been many more sound research proposals each year than were possible within budget limitations (only 20 percent of proposals have been funded).

10. The BNF Program has accomplished the training of a number of LDC scientists to date. It is important the administrators of the program conduct a review to determine which LDC's have not been represented in this or other BNF training programs and take appropriate steps to encourage their inclusion in the future.

Attachment 5

April 22, 1981

ACTION MEMORANDUM FOR THE DEPUTY ASSISTANT ADMINISTRATOR FOR FOOD AND NUTRITION BUREAU FOR DEVELOPMENT SUPPORT

FROM: DS/AGR, Donald Fiester

SUBJECT: Scope of Work, Team Evaluation - N - Fixation, Limiting Factors - Project 931-0610; PASA AG/TAB 610-9-76 with USDA/SEA/CR

Background

Your approval is requested to proceed with a team evaluation of the PASA with USDA/SEA/CR; the full title is "Symbiotic Nitrogen Fixation: Studies of Factors Limiting N - Fixation for LDC Crop Production." This project was initiated in April, 1976 for three years as recommended by RAC and was extended in April, 1979 for three years with present approval scheduled to expire April 14, 1982. This evaluation will provide guidance for A.I.D.'s decision on whether to continue the project another five years.

Recommendation

To carry out this evaluation, your approval is needed for not only the attached scope of work but also for the team travel expenses.

SMALL ACTIVITY PROGRAM FUNDS AVAILABLE: _____

APPROVED: _____

DISAPPROVED: _____

DATE: 5/12/81

Attachment: Scope-of-Work

CLEARANCES:

DS/AGR/RNR, LFrederick _____ Date 23 Apr. 81
DS/AGR/RNR, CSimkins _____ Date 23 Apr. 81
DS/AGR, MMorynski _____ Date 23 Apr. 81
DS/AGR, JWalker _____ Date 23 Apr. 81
DS/PO, ASilver _____ Date 5/12/81
DS/PO, FCampbell _____ Date 5/12/81
DS/PO, MRechcigl _____ Date _____

cc: DS/AGR/RNR, SEngberg
USDA, CSmith
Ohio State, RMiller

Attachment B

TEAM PROJECT EVALUATION

SCOPE OF WORK

A. Project Title: N-Fixation, Limiting Factors

Project Number: 931-0610

B. Name of Participating Agency: United States Department of Agriculture, Science and Education Administration, Cooperative Research, Washington, D.C.

Contract Number: PASA No. AG/TAB 610-9-76

C. Purpose and Rationale for Team Evaluation

This project resulted from the need to have qualified scientists to solve the problems that limit the usefulness of BNF technology. Since most the qualified scientists were scattered among U.S. universities, this project was conceived to provide relatively small grants for research on specific problems in the relatively broad spectrum of factors limiting the use of BNF. Through USDA-SEA-CR, sub-grants are awarded to scientists in U.S. institutions when their proposals are selected by peer review and the Selection Committee. After the first year's experience, the advantages of conducting research on limiting factors in the developing countries and in the U.S. by cooperating scientists led to a shift in the work to cooperative research. Most of the current grants have been awarded to support cooperative research between a U.S. institution and an institution in a developing country.

The services provided by USDA/SEA/CR include the following: (1) Delineation of Problem Areas - currently, (a) Factors limiting quality of inoculant and inoculation success, (b) Factors in the soil that limit successful BNF, and (c) Factors in the plant that limit nodulation and BNF, (2) Selection of Proposals for Sub-agreements (Sub-grants), (3) Subagreements, (4) Program Director and (5) Support Services. The PASA was initiated in FY 76 and is now in the second year of its first 3-year extension (5th year of project) and guidance is sought on project direction and continuation.

D. Team Composition

1. Soil scientist or agronomist - (JRC member) - with at least 10 years experience in research/teaching in soil microbiology, soils or crop production related to legume production. Must have a appreciation of tropical farming systems and BNF. Suggest Dr. F.E. Hutchinson, University of Maine (207-581-7462) or Dr. W. Phillip Warren, LAC/DR/RD (632-8605).

2. Agronomist or agricultural scientist - (RAC member) - with at least 10 years experience. Must have an appreciation of tropical legumes and BNF in farming systems. Suggest Dr. David Pimentel, Cornell University, (607-256-2212), or Dr. John Ehrenreich, University of Idaho (208-885-6441).

3. Soil Scientist with at least 10 years overseas experience. Suggest Dr. C. Simkins DS/AGR, (235-8993) or Dr. James Walker, DS/AGR (235-8893).

4. Soil microbiologist with at least 10 years experience with Rhizobium and BNF and with at least one year overseas experience. Suggest Dr. D. Weber, USDA/Beltsville (344-2736).

5. Agricultural Specialist - an agriculturalist with at least five years project management experience in A.I.D., mostly in an overseas environment. Suggest Dr. L. W. Fitzgerald (NE/TEC/AD), (632-8586) or Harold Jones (AFR/DR/ARD), (632-2727).

E. Other Participants

1. Dr. L. R. Frederick, DS/AGR project manager, will participate in all evaluation sessions.

2. Other representation from DS/AGR or regional bureaus is encouraged at their own expense.

F. Dates and Place of Evaluation

USDA South Building, Washington, D.C. - 29-30 June 1981.

G. Cost Analysis for Evaluation

It is believed that a team can be put together at no travel/per diem cost to DS/AGR, but RAC would probably not be represented. To have have the most desirable team, the costs are estimated to be,

1.	Travel/per diem for JRC member	$400
2.	Travel/per diem for RAC member	300
3.	Travel/per diem for others	N/C
	Total cost	$700

H. Project Background

This PASA was initiated with USDA/SEA/CR in April, 1976. By June, 1976, the initial sub-grants had been made. Sub-grants are made to U.S. institutions, with the U.S. institution passing through needed funds for cooperative research with institutions in developing countries.

Research on innovative inoculants has produced a method for incorporating rhizobia into fertilizer with good survival. Coal finely ground may be used as a carrier for rhizobia. Granular peat inoculants put in the row produce better nodulation under stress conditions than seed-applied inoculants. Survival of bean rhizobia (Rhizobium phaseoli) was very poor in some soils and may account for nodulation failure. Beans often respond to nitrogen fertilizer but breeding varieties with greater capability for nitrogen fixation appears promising, as does the work with cowpeas and peanuts. Good rhizobial strains often perform well in many different locations, but the need for locally adapted strains warrants further study.

From FY 76 to January, 1981, 41 sub-grants had been awarded to 21 U.S. institutions. Thirty-four American principal investigators with at least as many graduate students were involved. Many of the graduate students come from

countries other than the U.S. Cooperative work involved four international agricultural research centers (CIAT, ICRISAT, IFDC and IITA), and 16 countries (Nigeria, Morocco, Senegal, Turkey, Malaysia, Kenya, El Salvador, Brazil, Chile, Guyana, Thailand, Egypt, Sudan, Mexico, Panama and Venezuela) with at least 23 senior scientists from these countries involved. Each sub-grant is made for a three-year period with annual reports. For a three-year period, U.S. grants averaged about $50,000 and International cooperative grants averaged about $80,000. Meetings with the P.I.s are held at national and international scientific meetings. In 1981, a workshop was held at CIAT in Colombia where the BNF technology for the tropics was assessed with participation of nearly all of these sub-grant investigators. The workshop provided coordination of activities between different projects in A.I.D.'s program as well as information exchange and linkages with workers around the world. The proceedings will be published by CIAT. In one of the sessions, the group discussed the research needs for BNF technology. Graduate training of agricultural scientists is an integral part of most of these sub-grants. Many of the graduate students come from countries other than the U.S. A team evaluation of the project was conducted in October, 1978 and regular project evaluations have been made with the most recent in February, 1980.

I. Problems and Issues to be Addressed by the Team

The following specific items should be considered by the Team. Additional issues may be raised by USDA, A.I.D., or the Team.

The Team is requested to make an analysis of the results from this project that have been obtained that can be used by farmers. In addition, in those areas where usable results have not been obtained, the Team should make their best estimate of what usable results might be expected, what needs to be done, and when usable results will be ready for dissemination. The Team should make a definite recommendation regarding future funding.

1. Progress - is project proceeding satisfactorily? Are changes in timing needed?
2. Project design - effectiveness of the sub-grant approach, of the international cooperative research; suitability of sites and experimental designs; and appropriateness of limiting factors that have been identified.
3. Management of project operations - relations between A.I.D. and USDA, between USDA and research institutions, between U.S. institutions and foreign institutions, cost-effectiveness of project.
4. Personnel - adequacy of USDA staffing, stature of scientists participating in project.
5. Impact of unplanned events - changes in USDA staff.
6. Expected results - Publications; value of research results.
7. Recommendations - team recommendations regarding identification of limiting factors, ways to simplify procedures, continuation of project, level of effort, most promising approaches.

J. List of Documents

1. PASA between A.I.D. and USDA

2. Research Project Statement

3. Summary of Activities and CRIS Reports for Sub-Grants for 1980.

4. Project Officer's Project Review Summary - February, 1980.

5. Team Project Evaluation Summary and Report - October, 1978.

6. Samples of 1979 Narrative Project Reports.

K. Agenda for Review

1. May 30, 1981 Evaluation Plan approved

2. June 15, 1981 All travel arrangements finalized

3. July 15, 1981 Team evaluation completed

4. September 15, 1981 Original and 10 copies of Evaluation report submitted to DS/AGR.

PROJECT

CONTROLLED SUMMARY

ACTIVITY DATA SHEET

PROJECT MANAGER: L. H. Frederick

Nitrogen Fixation Limitation Factors	Agriculture, Rural Development and Nutrition	PROPOSED OBLIGATION (In thousands of dollars) FY 83: 500	LIFE OF PROJECT: UFAU
PROGRAM: Non-Region Current ☑ Other ☐	PRIOR II Congressional ☐	PRIOR REFERENCE: FY 1982 Annex V, Centrally Funded Programs, p.[illegible]	INITIAL OBLIGATION FY 76 / ESTIMATED FINAL OBLIGATION FY 87 / ESTIMATED COMPLETION DATE OF PROJECT FY [illegible]

Purpose: Determine solutions to problems limiting biological nitrogen fixation through an appropriate association between bacteria and agriculturally important crops especially legumes; to work cooperatively with LDC scientists on factors limiting BNF in their countries; support research by scattered, key research centers to overcome shortcomings in inoculation, in soil and in plant for legumes.

Background and Program to Date: Small Grants are awarded competitively within 8 months of inception of the project. Grantees are selected on basis of merit of these proposals in response to guidelines. A total of 41 grants have been made. Totally grants are for cooperative work between U.S. and LDC scientists. [illegible] up to $[illegible] for year research in U.S., up to $[illegible] for 4 years in cooperation with overseas scientists. Completion date for each separate project determined by SEA/CR. Project monitoring is joint between SEA/CR and A.I.D. Principal investigators meet annually for progress reports, for coordination and linkages, and for share expertise. In 1981, an international workshop with 200 participants was held at CIAT. An all-based inoculant that shows better survival at high temperatures and in fertilizer materials is being tested for field use. Trials show variation in BNF ability and often need a specific strain of host module further in (nitrogen). Improved BNF can also be selected in cowpea by breeding techniques, and a wide range of pH tolerance has been observed, indicating potential for adaptation to problem soils. BNF problems are being studied in Sudan (drought conditions, pest development), Egypt (salinity, phosphorus), Chile (temperate), El Salvador (inoculation methodology), Guyana and Thailand (inoculant [illegible]), Nigeria (inoculation, nitrogen fixation), Morocco and Senegal (inoculant [illegible]), Brazil (acidity, problem soils), Panama and Mexico (inoculation), Kenya (farm modification).

Host Country and Other Donors: Most grants show considerable (often matching) contribution from grantees. Cooperative work also shows support from cooperating country institutions, but varies from grant to grant. Support from grantees mostly on staff time and facilities. Subgrants have been made to 34 scientists in U.S. research institutions in 19 states. The states are Georgia, Minnesota, Mississippi, North Carolina, Washington, Alabama, Arizona, California, Florida, Hawaii, Ohio, Oregon, Texas, Montana, Wisconsin, Iowa and New Mexico, North Dakota and West Virginia.

Beneficiaries: Directly, scientists, indirectly, small farmers in LDCs as results are incorporated into crop management. Chile ($2,000/yr.), Nigeria ($6,000/yr.), El Salvador ($5,000/yr., Brazil ($6,000/yr.), Thailand ($6,000/yr.), Egypt ($[illegible]), Morocco and Senegal ($7,000/yr.), Guyana ($2,000/yr.), Panama ($2,000/yr.), Mexico ($[illegible]/yr.), Sudan ($6,000/yr.), Turkey ($1,000/yr.), Venezuela ($[illegible]/yr.), Nepal ($7,000/yr.), Kenya ($1,500/yr.).

FY 83 Program: To continue research with priority on overseas cooperative efforts.

Major Outputs and A.I.D. Inputs:	All Years Units
Subgrants to research institutions	46
Improved inoculant materials	2
Improved inoculant practices	8
Ways to overcome factors limiting biological nitrogen fixation	12
Cooperative BNF research with LDC scientists	25
Trained personnel to work on problems related to biological nitrogen fixation	43
Technical publications	49

A.I.D. Financed Inputs in $000s:	FY 83
Research subgrants	$500
TOTAL	$500

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U.S. FUNDING (In thousands of dollars)	Obligations	Expenditures	Unliquidated	Funding Period	Principal Contractors or Agencies
Through September 30, 1980	2500	1950	550		USDA/SEA/CR – U.S. Dept. of Agriculture Science and Education Administration Cooperative Research
Estimated Fiscal Year 1981	800	550		4/15/81 to 4/15/82	
Estimated through September 30, 1981	2500	2500	800		
Proposed FY 1982	650	700		4/15/82 to 4/15/83	
Estimated through Fiscal Year 1982	3850	3200	350		
Proposed FY 83	500	Future Year Obligations	Estimated Total Cost	4/15/83 to 4/15/84	
		2500	UFAU		

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Life of Project
From FY 76 to FY 81
Total U.S. Funding $3,100,000 (6 yr)
Date Prepared Dec. 78

Project Title & Number Symbiotic Nitrogen Fixation, Factors Limiting

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Program or Sector Goal: The broader objective to which this project contributes Increase food production and improve quality of life of small farmer through better soil and water management.	Measures of Goal Achievement Increased use of legumes in cropping systems. Increased yields of legumes		Assumptions for achieving goal targets: Sufficient interest in LDC to adopt improved practices.
Project Purpose Support research by key research workers to find new and better ways to overcome problems that prevent optimum use of biological nitrogen fixation in farming systems of LDCs.	Conditions that will indicate purpose has been achieved: End of project status Be able to deliver viable, high quality inoculant under rural, simulating transport and storage in LDCs in the tropics. Reliable and effective nodulation of legume crops. Increase use of fertilizer nitrogen on legumes.	1. Annual reports from investigators 2. CR/SEA/USDA records	Assumptions for achieving purpose: Major limiting factors in legume biological nitrogen fixation can be overcome. Adequate scientific personnel can be found.
Outputs 1. Improved inoculant materials and procedures. 2. Trained personnel to work on problems related to biological nitrogen fixation. 3. Information regarding ways to overcome factors limiting BNF. 4. Cooperative BNF research with LDC scientists.	Magnitude of Outputs 1. New methods of making inoculant preparations. 2. Some graduate students achieve M.S. or Ph.D degrees 3. Several scientific publications and graduate degree thesis.	1. On-site visits by USB and USDA project managers. 2. Annual reports from investigation. 3. Copies of publications. 4. Copies of Memoranda of Agreement with LDC institutions.	Assumptions for achieving outputs: Adequate number of interested investigators with facilities Adequate numbers of graduate students.
Inputs 1. AID provides financial support and project guidance. 2. CR/SEA/USDA provides project management, including selection of grantees. 3. Several small research grants, either competitive or negotiated.	Implementation Target (Type and Quantity) 1. AID funding at about $550,000 per year for 3 years and provide project officer. 2. CR/SEA/USDA - Program Director (2 months) and support services. 3. For $100,000, 1 to 2 senior scientist years, 1 to 3 junior scientist years, 5 to 10 graduate student years and 1 to 10 technical aide years plus facilities both lab and field and support services.		Assumptions for providing inputs: