

PD-AAW-489
52523

ANNUAL PROJECT REPORT

FY 1986

Project Title: Special Grants for Research
on Factors Limiting Symbiotic Nitrogen Fixatio
for Crop Production in Developing Countries
(PASA AG/TAG-610-9-76)

Contractor: U. S. Department of Agriculture
Cooperative State Research Service
Washington, DC 20250

Date of Report: May 1987

Project Manager: Gerald H. Elkan

Department of Microbiology
North Carolina State University
Raleigh, North Carolina 27695

PROGRAM ADMINISTRATIVE SUMMARY

Nature of the Program

The USDA-CSRS-AID Biological Nitrogen Fixation Program funded under PASA Agreement (PASA AG/TAB-610-9-76) has been in effect for slightly over nine years. The general problem areas in biological dinitrogen fixation by food, feed, and fuel legumes are delineated for major emphasis in these agreements.

In 1986 proposals concentrated on cultivar-strain-soil interactions to improve the biological nitrogen fixation (BNF) capacity and yield of field-grown legume crops in developing countries. Funding preferences were given to those proposals employing a combination of biotechnological and applied or developmental research methodologies. More specifically, the following research needs were stressed: (1) factors optimizing rhizobia and inoculation success, (2) factors in the soil to enhance successful BNF, (3) factors in the plant that optimize nodulation and BNF, and (4) factors that optimize the use of BNF in cropping systems. For use in developing countries, the research addressed inoculation and BNF problems of food, forage, and tree legumes. Research on tree legumes is directed to their use in agroforestry systems, for firewood or for conservation of tropical soils. Also considered was intercropping of forage or food legumes with nonleguminous trees. Research on soybeans or peanuts was not funded this year.

Project Selection Procedure

Solicitation procedures for research proposals have expanded since inception of the program. Announcements (Attachment B) were sent to each of the Landgrant Universities (via experiment station directors), the 1894 Universities plus the University of Puerto Rico and the College of the Virgin Islands. Additional announcements were sent to other universities where there are groups working with biological nitrogen fixation, appropriate research centers and private industries. Verbal announcements were made during appropriate sessions at the annual meetings of the American Society for Microbiology and the American Agronomy Society. As a result of these announcements, a mailing list of individuals totaling nearly 200 has been established.

Investigators were requested to submit 2- to 3-page pre-proposals using announcement guidelines. For FY 1986, 36 such pre-proposals were submitted (Attachment C). These pre-proposals were evaluated by a panel appointed by the Program Manager (G. H. Elkan) with the counsel of Dr. Lloyd R. Frederick (USAID, S&T/AGR). Affiliations of the eight-member panel were as follows: 3 USAID, 3 USDA, 1 retired, and 1 university. All panelists were knowledgeable in areas of biological nitrogen fixation. The panel recommended 11 pre-proposals for expansion and submission as full proposals (Attachment C). Funding was available for four to five projects in FY 1986 and FY 1987.

Each full proposal was reviewed and evaluated by at least three independent reviewers. A copy of the review criteria is attached (Attachment D). Reviewers were selected by the program manager from a listing of 60 biological nitrogen fixation researchers. Only investigators who had not submitted pre-proposals during FY 86 were selected as reviewers. These reviews were considered by the same panel which evaluated the pre-proposals.

The following five projects were recommended for funding in FY 1986 and FY 1987:

| <u>Investigator</u> | <u>Proposal title</u> | <u>Grant amount</u> |
|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|---------------------|
| J. R. Sims Plant and Soil Science Montana State University Bozeman, MT 59717 | Dryland legume/cereal rotations for Egypt and similar areas | \$82,500 FY 87 |
| D. L. Lathwell Dept. of Agronomy Cornell University Ithaca, NY 14853 | Screening legumes for dry season survival in acid savanna tropics | \$80,000 FY 86 |
| C. B. Davey Dept. of Soil Science N. C. State University Raleigh, NC 27695 | Mycorrhiza and phosphorus effects on biological nitrogen fixation in tropical pastures and alley cropping systems | \$81,500 FY 86 |
| R. L. Todd Dept. of Microbiology South Dakota State Univ. Brookings, SD 57007 | Role of mycorrhizal fungi in nitrogen fixation in legume- maize intercropping | \$81,000 FY 87 |
| D. F. Bezdicsek Agronomy and Soils Washington State Univ. Pullman, WA 99164 | Detection of <u>Rhizobium</u> in soil, rhizosphere and nodules by DNA probe | \$86,000 FY 86 |

Program Progress Reporting Procedure

Principal investigators are required to submit to USDA/CSRS and USAID annual progress reports and a comprehensive final report. In 1986 past and present principal investigators were asked to help with a special USAID program report for dispersal to USAID field officers and other decision-makers. They complied by sending written impacts and breakthroughs and labelled slides. These were submitted as of February 1986. The program manager is presently summarizing data for this publicity brochure.

Program Summary

A total of 82 grants have been awarded to 53 American scientists in 30 universities or research institutions (see Attachment A for a complete listing of projects, principal investigators and total budgets, and Attachment H for a listing of institutions). Currently,

22 projects are active including the five funded in FY 86-87. The average funding per project is approximately \$57,000/3 years with approximately 50% of the funding designated for overseas collaboration.

Initially, this program did not require a formal overseas collaboration, but all of the 22 currently active projects do have an active LDC linkage. It is unlikely that a future project without such linkage would be recommended for funding. Currently, 30 scientists in 19 LDC countries are active collaborators (see Attachment F for a listing of LDC scientists and their institutions and Attachment G for countries represented). Distribution of active projects is as follows: 1 in Barbados, Cameroon, Ecuador, Honduras, Kenya, Malaysia, Nepal, Pakistan, Panama, Peru, Santa Domingo, Swaziland, Tunisia, Turkey and Venezuela; 2 in Brazil and Egypt; and 3 in Mexico and the Philippines.

Cooperative relationships have also developed with the following international centers: ICRISAT, Hyderabad, India; IITA, Ibadan, Nigeria; CIAT, Cali, Colombia; and the International Fertilizer Development Center, Muscle Shoals, Alabama.

A listing of publications directly resulting from these projects is included in Attachment I. Abstracts and oral presentations are not included. The most tangible form of information dissemination of research results to the largest group of potential users. Because of the length of time required for the completion and publication of field data, additional publications are in preparation resulting from completed projects.

Major changes in the direction, method of management, or organization are not planned at this time. Rather, we will hope to improve the program by evolution. As initially conceived by Dr. L. R. Frederick, USAID/S&T/AGR, this program has a uniqueness which could service as a model for other such agricultural development programs. For relatively little money (\$90,000/3 years maximum) a collaborative research project is established between a U.S. institution and principal investigators and an LDC institution and investigator(s). This has resulted in the building of firm linkages. Approximately 50% of each project budget is expended by or on behalf of the LDC collaborator. Because the total budget is administered by the U.S. institution governed by USDA/CSRS rules, there has been effective management of the overseas funds and research productivity.

The success of the program is causing at least one problem. Funds available allow funding 4-5 projects yearly. Each year there are new investigators and institutions, submitting good, fundable proposals which would result in broader collaboration between U.S. institutions and new LDC locations. At the same time a number of funded projects expire after the P.I.'s have built firm constructive linkages and have developed productive, collaborative research projects. The project review panels are cognizant of the need for broadening the program base by encouraging new investigators and new collaborations. On the other hand, it is important to retain and nurture existing productive linkages and collaborations. Therefore,

it would seem most beneficial to the mission of USAID/S&T/AGR if there would be a modest increase in funds to allow the funding of an additional 3-5 projects yearly. This would allow a better balance between established and new applicants and countries. Most importantly, these extra projects could be supported with maintenance of the current level of research quality.

ATTACHMENTS

- A. PROJECTS FUNDED UNDER PROGRAM
- B. ANNOUNCEMENTS ON PROPOSALS AND PROCEDURES
- C. PREPROPOSALS RECEIVED IN 1983
- D. REVIEWER'S SCORING FORM
- E. PROJECT P.I. MAILING LIST
- F. FOREIGN P.I. AND COOPERATORS
- G. PROJECT LDC COUNTRIES REPRESENTED
- H. PROJECT INSTITUTIONS WITH GRANTS
- I. PUBLICATIONS RESULTING FROM PROJECT
- J. GRADUATE STUDENTS SUPPORTED ON PROGRAM FUNDS
- K. SUMMARY OF NUMBERS OF PROJECTS DEALING WITH SPECIFIC LEGUMES

Attachment A

PROJECTS FUNDED UNDER USDA-SEA/CR-AID BNF PROGRAM

Fiscal Year 1976

| <u>Grantee</u> | <u>Budget</u> | <u>Project</u> | <u>P.I.</u> | <u>Overseas coll.</u> |
|------------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|-----------------------|
| *GA-AES 616-15-191 | \$45,000 | Evaluation of rhizobial inoculants and methods of inoculation to improve LDC legume productivity (9/30/76-9/30/79) | D. O. Wilson Dept. of Agronomy Univ. of Georgia Georgia Sta., GA 30212 | |
| *MN-AES 616-15-190 | \$45,000 | Factors significant to the success of <u>Rhizobium phaseoli</u> in the soil and rhizosphere of <u>Phaseolus</u> (6/30/76-6/30/79)--Extended to 6/30/80--Extended to 6/30/81 | E. L. Schmidt G. E. Ham Dept. of Soil Sci. Univ. of Minnesota St. Paul, MN 55108 | |
| *MS-AES 616-15-188 | \$45,000 | Development of an improved legume inoculant for use in developing countries (9/30/76-9/30/79)--Extended to 9/30/80 | H. Peterson Dept. of Agronomy Miss. State Univ. Mississippi State, MS 39762 | |
| *WA-AES 616-15-189 | \$45,000 | Factors limiting symbiotic dinitrogen fixation in <u>Phaseolus vulgaris</u> (6/30/76-6/30/79) | D. F. Bezdicsek Dept. of Agron. & Soils Wash. State Univ. Pullman, WA 99164 | |
| *NC-AES 616-15-192 701-15-24 | \$21,786 \$23,214 | Compatibility effects of strain and host genotype on inoculant effectiveness in peanuts (6/30/76-6/30/79) | J. C. Wynne Dept. of Crop Sci. G. H. Elkan Dept. of Microbiol. N. C. State Univ. Raleigh, NC 27650 | |

Fiscal Year 1977

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|----------------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|--|
| *AL-AES 701-15-18 | \$38,950 | The effects of seed treatment fungicides on the <u>Rhizobium</u> host infection process in LDC legumes (2/16/77-4/30/80) | P. Backman Dept. of Botany, Plant Path. & Microbiology Auburn Univ. Auburn, AL 36849 | |
| *AZ-AES 701-15-62 | \$45,000 | Nitrogen-fixation efficiency of cowpeas and mung beans and rhizobia spp. in saline-alkali soils (4/18/77-4/17/81) | V. Marcarian Plant Sci. Dept. I. L. Pepper Dept. of Soils, Water & Engineering Univ. of Arizona Tucson, AZ 85721 | |
| *CA-AES 701-15-19 | \$45,000 | Symbiotic nitrogen fixation in <u>Phaseolus vulgaris</u> , <u>Mungo</u> , <u>Vigna unguiculata</u> , and <u>Cicer arietinum</u> (1/17/77-1/31/81)--Extended to 1/16/82 | B. D. Webster Dept. of Agron. & Range Sci. D. D. Munns Dept. of Land, Air & Water Resources Univ. of Calif. Davis, CA 95616 | |
| *FL-AES 701-15-63 | \$45,000 | Factors limiting symbiotic nitrogen fixation for edible food legumes in developing countries (extended to 8/17/80) | W. T. Scudder Univ. of Florida Agric. Res. & Educ. Centr. P. O. Box 90 Sanford, FL 32771 | |
| *HI-AES 701-15-60 | \$45,000 | Environmental limitations on the performance of <u>Rhizobium</u> in tropical soils (4/18/77-4/17/80)--Extended to 4/17/81 | B. B. Bohlool Dept. of Microbiology Univ. of Hawaii Honolulu, HI 96822 | |

*Inactive.

Attachment A (cont.)

Fiscal Year 1977 (Cont.)

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|------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| * MN-AES 701-15-61 | \$45,000 | Factors limiting the viability of <u>Rhizobium phaseoli</u> in inoculants (4/18/77-4/17/80)--Extended to 4/17/81 | G. E. Ham L. L. Schmidt Dept. of Soil Sci. Univ. of Minnesota St. Paul, MN 55108 | |
| * ND-AES 701-15-64 801-15-97 | \$24,265 \$8,500 | Alternative carrier materials for <u>Rhizobium phaseoli</u> inoculants (4/18/77-9/30/81) | D. L. Berryhill Dept. of Bacteriology N.D. State Univ. Fargo, ND 58105 | |
| * OH-AES 701-15-20 | \$45,000 | Biotic and abiotic factors which influence saprophytic competence of strains of <u>Rhizobium phaseoli</u> (1/17/77-1/31/81)--Extended to 6/30/81 | R. H. Miller Dept. of Agronomy OARDC Ohio State Univ. Columbus, OH 43210 | |
| * OR-AES 701-15-69 | \$45,000 | Effects of selected <u>Rhizobium</u> strains and inoculation methods on Chilean alfalfa and lentil yields (6/9/77-6/8/80) | W. Murphy Dept. of Plant & Soil Sci. Univ. of Vermont Burlington, VT 05405 | Scientists at Carillanca Sta., Human Sta., & DIPEX in Chile |
| * TX-AES 701-15-59 | \$45,000 | Maximizing symbiotic nitrogen fixation utilizing cowpea genotypes and specific <u>Rhizobium</u> strains (4/18/77-4/17/80) | J. C. Miller, Jr. Dept. of Hort. Sci. R. W. Weaver Dept. of Soil & Crop Sci. Texas A&M Univ. College Sta., TX 77843 | |

Fiscal Year 1978

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|----------------------|----------|----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| *CA-AES 801-15-23 | \$54,000 | Edaphic tolerances of grain legumes (3/24/78-1/23/82) | D. N. Munns Dept. of Land, Air & Water Resources Univ. of Calif. Davis, CA 95616 | |
| *CA-AES 801-15-25 | \$30,960 | Genetic enhancement of symbiotic nitrogen fixation in chickpea through breeding of the host plant (3/24/78-3/23/83) | K. W. Foster C. L. Tucker D. A. Phillips Dept. of Agron. & Range Sci. Univ. of Calif. Davis, CA 95616 | |
| *FL-AES 801-15-91 | \$66,149 | Establishment of a bean inoculation program applicable to small farms in developing countries (8/8/78-8/7/81)--Extended to 8/7/82 | D. H. Hubbell Dept. of Soil Sci. Univ. of Fla. Gainesville, FL 32611 | Carlos M. Garcia Dept. Fitotecnia CENTA San Salvador, El Salvador |
| *GA-AES 801-15-24 | \$45,000 | Field evaluation of inoculation methods to enhance nitrogen fixation by food legumes in Nigeria (3/22/78-3/21/81)--Extended to 3/21/82 | D. O. Wilson Dept. of Agronomy Univ. of Ga. Ga. Sta., GA 30212 | C. T. I. Odu Agron. Dept. Univ. of Ibadan Ibadan, Nigeria |
| *MN-AES 801-15-67 | \$91,471 | Soil adaptability of rhizobia for food legume production in west Africa (6/19/78-6/18/81)--Extended to 6/18/83 | E. L. Schmidt J. A. E. Molina Dept. of Soil Sci. Univ. of Minn. St. Paul, MN 55108 | Scientists at Morocco & Senegal |
| *MT-AES 801-15-66 | \$75,000 | Effects of salinity and water stress on symbiotic nitrogen fixation (6/16/78-10/31/81)--Extended to 4/15/82 | J. R. Sims R. H. Lockerman Dept. of Plant & Soil Sci. Montana State Univ. Bozeman, MT 59717 | A. S. Abdel-Ghaffar Univ. of Alexandria Alexandria, Egypt |

*Inactive.

Attachment A (cont.)

Fiscal Year 1978 (Cont.)

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|-----------------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| * NC-AES 801-15-93 | \$65,000 | Increased efficiency of peanut production through enhanced biological nitrogen fixation (9/9/78-9/7/81)--Extended to 8/31/83 | J. C. Wynne G. H. Elkan (address earlier) | R. W. Gibbons ICRISAT India |
| * OH-AES 801-51-64 | \$45,000 | Survival of <u>Rhizobium phaseoli</u> in Ultisols and Oxisols of Brazil (5/11/78-5/10/81)--Extended to 5/31/82 | R. H. Miller (address earlier) | C. Vidor Porto Alegre, Brazil |
| * TX-AES 801-15-38 | \$2,354 | Transfer mechanism for introduction of improved N ₂ fixing cowpea genotypes into developing nations (supplement to FY1977 grant) (4/15/78-4/24/79) | J. C. Miller, Jr. (address earlier) | Scientists at IITA, Ibadan, Nigeria |
| * TX-AES 801-15-92 | \$74,694 | Stability of effectiveness in cowpea rhizobia (9/8/78-9/7/81)--Requested extension to 9/7/82 | R. W. Weaver (address earlier) | H. B. Persaud Centri. Agr. Sta. Mon Repos, Guyana N. Boonkerd Dept. Agric. Bangkok, Thailand |
| * WI-AES 801-15-36 | \$75,000 | Genetic analysis of host factors affecting nitrogen fixation in common beans (4/14/78-4/13/82) | F. A. Bliss Dept. of Horticulture Univ. of Wisc. Madison, WI 53706 | P. Graham CIAT |

Fiscal Year 1979

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|----------------------|----------|--------------------------------------------------------------------------------------------------------------|-------------------------------------|---------------------------------------------|
| MS-AES 901-15-197 | \$54,000 | Evaluation of fertilizer-base inocula for use in developing countries (9/28/79-9/30/82)--Extended to 9/27/84 | H. L. Peterson (address earlier) | Scientists at IFDC, Muscle Shoals, AL |
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Fiscal Year 1980

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|------------------------------|----------|------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| *CA-AES 59-2064-0-5-008-0 | \$23,999 | Effects of inoculation upon N-fixation in <u>Cajanus cajan</u> (11/26/79-9/30/81) | D. D. Focht Dept. of Soil & Env. Sci. Univ. of Calif. Riverside, CA 92521 | B. de Hernandez Univ. of Panama Rep. of Panama |
| *GA-AES 59-2131-0-5-013-0 | \$24,000 | Assessment of need for micronutrients for nodulation, N fixation and growth of cowpeas in Nigeria (2/13/80-8/31/81)--Extended to 6/30/82 | D. O. Wilson L. M. Shuman (address earlier) | C. T. I. Odu A. A. Agboola E. J. Udo T. A. T. Wahua Dept. of Agron. Univ. of Ibadan Ibadan, Nigeria |
| *HI-AES 59-2151-0-5-012-0 | \$90,000 | Better legume inoculants for acid, infertile soils of the tropics (2/27/80-1/31/83)--Requested extension to 12/31/83 | J. Halliday Univ. of Hawaii NIFTAL Project P. O. Box "O" Paia, HI 96779 | A.M.Q. deEscuder N. M. de Sousa Costa EPAMIG Minas Gerais, Brazil J.R. Jardim Freire UFRCG Porto Alegre, Brazil J. Soares Pereira IPAGRO |
| *IA-AES 59-2191-0-5-010-0 | \$69,000 | Groundnut inoculation in Sudan (1/28/80-1/31/83)--Extended to 1/31/84 | T. E. Loynachan Dept. of Agron. Iowa State Univ. Ames, IA 50011 | M. M. Musa A. Harndoun N. O. Mikhtar Agric. Res. Corp. Wad Medani, Sudan |

*Inactive.

- Attachment A (cont.)

Fiscal Year 1980 (Cont.)

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| *MT-AES 59-2301-0-5-011-0 | \$90,000 | Effects of phosphorus fertilization on symbiotic nitrogen fixation by beans (1/18/80-7/31/83)--Extended to 12/31/83 | J. R. Sims R. H. Lockerman (address earlier) | A. S. Abdel-Ghaffar (address earlier) |
| *NM-AES 59-2351-0-5-009-0 | \$24,000 | Maximizing nitrogen fixation in common beans (12/17/79-2/28/82) | W. C. Lindemann Dept. of Agronomy N.M. State Univ. Las Cruces, NM | V. Lee-Rodriguez CENAMAR Gomez Palacio, Durango Mexico |
| *TX-AES 59-2481-0-5-001-0 | \$54,000 | Enhanced nitrogen fixation utilizing high fixing drought tolerant cowpea genotypes (11/15/79-11/14/82)--Extended to 11/30/83 | J. C. Miller, Jr. (address earlier) | |

Fiscal Year 1981

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|----------------------------------------|----------|---------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| AZ-AES 59-2041-1-5-004-0 | \$87,982 | Isolation and evaluation of inoculants for woody legumes in Veracruz, Mexico (9/1/81-9/30/84) | I. L. Pepper J. P. Roskoski 436 Agr. Sci. Bldg. Tucson, AZ 85721 | I. E. Pardo Tajeda INIRB km 2.5 Antigua, Carretera A Coatepec, Xalapa, Veracruz, Mex. |
| CA-AES 59-2063-1-5-005-0 | \$82,390 | Legume-Rhizobium symbiosis in P deficient acid soils (9/1/81-9/30/84)--Extended to 9/30/85 | D. N. Munns V. W. Fogle (address earlier) | A. A. Franco Emp. Bras. de Pesquisa Agropec. Rio de Janeiro, Brazil |
| *CA-AES 59-2063-1-5-011-0 | \$54,000 | Selecting Phaseolus, Vigna, and Cicer for enhanced symbiotic nitrogen fixation (7/1/81-6/30/84) | D. A. Phillips K. W. Foster (address earlier) | |
| *CA-AES 59-2064-0-5-017-0 | \$44,614 | Soil factors in Panama which affect the symbiosis of Rhizobium on Cajanus cajan (9/15/80-6/30/83)--Extended to 8/31/83 | D. D. Focht (address earlier) | B. C. de Hernandez Univ. of Panama Panama |
| *III-AES (NIFTAL) 59-2151-0-5-016-0 | \$56,960 | International workshop: Biological nitrogen fixation (BNF) technology for tropical agriculture (7/1/80-12/31/81) | J. Halliday (address earlier) | |
| *NM-AES 59-2351-1-5-007-0 | \$59,937 | Common bean nitrogen fixation in the northern plateau region of Mexico (1/1/82-12/31/84)--Extended to 9/30/85 | W. C. Lindemann (address earlier) | R. Mancilla y Diaz-I. CIAN-INIA Mexico 6, D.F. Mex. |
| *NC-AES 59-2371-0-5-015-0 | \$84,020 | Nitrogen fixation of peanuts in Malaysia (9/15/80-9/30/83)--Extended to 9/30/84 | J. C. Wynne (address earlier) | F. Wahab RRIM Malaysia |
| NC-AES 59-2371-1-5-010-0 | \$83,680 | Determination of factors limiting symbiotic nitrogen fixation in peanuts grown in Savanna soils (7/1/81-6/30/84)--Extended to 6/30/86 | G. H. Elkan (address earlier) | J. P. Ekebil I.R.A. Maroua, Cameroon |
| NC-AES 59-2371-1-5-008-0 | \$80,830 | Factors limiting symbiotic nitrogen fixation for LDC crop production (10/1/81-9/30/84) | A. G. Wollum, II Dept. of Soil Sci. N. C. State Univ. Raleigh, NC 27650 | F. Munevar M. Univ. Nac. Colombia Colombia, Venezuela |
| *NC-AES 59-2371-1-5-009-0 | \$27,850 | A workshop on biological nitrogen fixation for tropical agriculture (10/1/81-9/30/82) | H. D. Gross Crop Sci. Dept. N. C. State Univ. Raleigh, NC 27650 | |
| *TX-AES 59-2481-0-5-018-0 | \$90,000 | Competitive nodulation and growth of cowpeas (9/15/80-9/30/83)--Extended to 9/30/84; extended to 1/31/85 | R. Weaver (address earlier) | Y. Vasuvat Kasetsart Univ. Bangkok, Thailand A. Trotman Ministry of Agric. Mon Repos, Guyana |

*Inactive.

Attachment A (cont.)

Fiscal Year 1981 (Cont.)

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| *WA-AES 59-2531-1-5-002-0 | \$25,000 | Improvement of nitrogen fixation and yield of lentils in Turkey (1/1/81-2/28/82) | D. Bezdicsek (address earlier) | I. Cakmakci Univ. of Ankara Ankara, Turkey |
| *WV-AES 59-2541-1-5-001-0 | \$20,000 | Production and utilization of grass/legume pastures in eastern Venezuela (3/1/81-2/28/82)--Extended to 2/29/84; extended to 8/31/84 | W. B. Bryan Div. Plant & Soil Sci. W.V. State Univ. Morgantown, WV | P. Jaurequi UNELLEZ R. Medina FUSAGRI |
| *WI-AES 59-2551-1-5-006-0 | \$90,000 | Breeding beans for improved BNF with native and selected <u>Rhizobium phaseoli</u> (10/1/81-9/30/84)--Extended to 4/30/85 | F. A. Bliss (address earlier) | J. Chang Escuela Agricola Panamericana Tegucipala, Hond. |

Fiscal Year 1982

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|------------------------------------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| FL-AES 82-CRSR-5-0204 | \$40,000 | <u>Meloidogyne</u> spp. as limiting factors on N ₂ fixation from crop production in developing countries (10/1/82-9/30/85) | D. D. Baltensperger K. H. Quesenberry Dept. of Agronomy Univ. of Florida Gainesville, FL 32611 | S. F. Pasley H. D. C. Mslska V. W. Saka A. Daudi Rep. of Malawi |
| FL-AES 82-CRSR-5-0207 | \$63,000 | Soil factors limiting soil nitrogen fixation in beans in Honduras (10/1/82-9/30/85)--Extended to 9/30/86 | D. H. Hubbell J. B. Sartain (address earlier) | J. Chang Escuela Agricola Panamericana Tegucipala, Hond. |
| KY-AES 82-CRSR-5-0200 | \$42,000 | Tillage and inoculation effects on nitrogen fixation by grain legumes in the Dominican Republic (10/1/82-9/30/84)--Extended to 9/30/85 | M. S. Smith G. W. Thomas R. L. Blevins Dept. of Agronomy Univ. of Kentucky Lexington, KY 40546 | Grant Thomas (AID) Scientists at CENDA |
| MN-AES 82-CRSR-5-0202 | \$77,167 | Factors affecting the competitive ability of isolates of <u>R. phaseoli</u> (11/1/82-10/31/85)--Extended to 9/30/86; extended to 6/30/87 | P. H. Graham Dept. of Soil Science Univ. of Minn. St. Paul, MN 55108 | C. Vidor Rio Grande do Sul, Porto Alegre, Braz. J. Peres, CPAC Planaltina, D.F., Brazil |
| NY-AES 59-2361-1-5-012-0 81-CRSR-5-0-101 | \$51,005 \$38,992 | Exploiting BNF in maximizing legume yields in tropical cropping systems (7/1/81-3/31/84) | T. L. Setter T. Scott Dept. of Agron. Cornell Univ. Ithaca, NY 14850 | R. A. Graham A. L. Donawa N. Ahmad Univ. W. Indies Trinidad, W.I. |
| OR-AES 82-CRSR-5-0205 | \$59,802 | Maximizing N ₂ fixation and yield of forage legumes grown in Tunisia (10/1/82-9/30/84)--Extended to 9/30/86; extended to 9/14/87 | D. B. Hannaway W. Jarrell Crop Sci. Dept. Oregon State Univ. Corvallis, OR 97331 | M. Zouaghi INIAT Tunis, Tunisia |
| TX-AES 82-CRSR-5-0201 | \$68,000 | Maximization of cowpea production efficiency and yield utilizing BNF, mycorrhizae association and enhanced phosphorus uptake (10/1/82-9/30/85) | J. C. Miller, Jr. (address earlier) | S. Rajapakse Fac. of Agric. Univ. Peradeniya Sri Lanka E. H. Prophetette Min. of Agric. DARNDR-SERA Damien, PAP, Haiti |
| *WA-AES 82-CRSR-5-0206 | \$41,000 | Improvement of nitrogen fixation and yield of lentils and chickpeas in Turkey (10/1/82-9/30/84)--Extended to 9/30/85 | D. F. Bezdicsek (address earlier) | I. Cakmakci Turkey |
| WI-Nitragin Co. 82-CRSR-5-0203 | \$30,000 | Storage and hand application of granular inoculant in Costa Rica (10/1/82-9/30/85) | R. S. Smith The Nitragin Co., Inc. 3101 W. Custer Ave. Milwaukee, WI 53209 | C. Ramirez M. C.I.A. Univ. de Costa Rica San Pedro, C.R. |

Fiscal Year 1983

| | | | | |
|------------------------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------------------|
| CA-AES 83-CRSR-2-2320 | \$78,966 | Competition between rhizobial inoculants and indigenous rhizobia (6/1/83-9/30/86)--Extended to 11/30/86 | D. D. Focht (address earlier) | B.C. dellernandez Panama |
| *HI-NIFTAL 84-CRSR-2-2369 | \$50,000 | Workshop for assessing and planning collaborative research on factors limiting biological nitrogen fixation by tropical legumes (10/1/83-9/30/86) | J. P. Roskoski (address earlier) | |

Attachment A (cont.)

Fiscal Year 1983 (Cont.)

| | | | | |
|--------------------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| MC-AES 83-CRSR-2-2321 | \$77,462 | Acid soil tolerance of bean cultivars and rhizobia (10/1/83-9/30/86)--Extended to 9/30/87 | P. H. Graham (address earlier) | C. E. Salazar INIAP Pasilla Postal 340 Quitto, Ecuador |
| MT-AES 83-CRSR-2-2319 | \$89,932 | Effect of soil moisture on N ₂ fixation and yield of chickpea (<i>Cicer arietinum</i> L.) genotypes (10/1/83-8/1/86)--Extended to 9/30/87 | R. L. Lockerman F. J. Muehlbauer J. R. Sims G. Westesen (address earlier) | A.S. Abdel-Ghaffar El-Attar Hatim Univ. of Alexandria Alexandria, Egypt |
| NC-AES 84-CRSR-2-2370 | \$60,000 | Increasing nitrogen fixation of inter-cropped peanuts in Malaysia and the Philippines (4/1/84-3/31/87) | J. C. Wynne (address earlier) | R. Abilay IBP Philippines Z. Shamsuddin Soil Sci. Dept. Univ. Pertanian Malaysia |
| VA-AES 83-CRSR-2-2324 | \$46,000 | Increasing survival of pigeon pea rhizobial inoculant in Sri Lanka soil (10/1/83-9/30/85) | J. L. Neal Dept. of Biology Virginia PI&SU Blacksburg, VA 24061 | M. K. Gunatilaka C.A.R.I. Peradeniya, Sri Lanka |

Fiscal Year 1984

| | | | | |
|--------------------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| AZ-AES 85-CRSR-2-2539 | \$15,000 | Optimization of inoculation response by <i>Leucaena leucocephala</i> in Veracruz, Mexico (3/1/85-2/28/87) | I. L. Pepper Dept. Soils, Water & Engineering Univ. Arizona Tucson, AZ 85721 | Ing. E. Pardo-Tajeda INIREB Apd. Postal 63 Xalapa, Veracruz Mexico |
| FL-AES 84-CRSR-2-2520 | \$80,000 | Nitrogen fixation in acid soils by forage legumes: Enhanced by VA mycorrhizae (9/15/84-9/30/87)--Extended to 9/30/88 | N. C. Schenck Plant Pathology Dept. Univ. Florida Gainesville, FL 32611 | Dr. Reynaldo D. Cruz Dept. of Forestry Biol. Sciences Univ. of the Phil. Laguna, Philippines |
| GA-AES 84-CRSR-2-2517 | \$79,363 | Use of legumes for N ₂ -fixation, forage quality, and erosion control in Nepal (9/15/84-9/30/87)--Extended to 3/31/89 | J. H. Bouton Agronomy Dept. Univ. Georgia Athens, GA 30602 | D. R. Pradhan Ministry of Agric. Nepal (Kathmandu) |
| PR-AES 85-CRSR-2-2535 | \$53,442 | Increasing <i>Phaseolus vulgaris</i> yields in the Dominican Republic by optimizing the host/strain (<i>R. phaseoli</i>) symbiosis (1/1/85-12/31/87) | E. C. Schroder Dept. Agron. & Soils Univ. Puerto Rico Mayaguez, PR 00708 | Agr. Rafael Martinez Richiez (Min. Agric. Agr. H. R. Reynoso Fac. Agron., Univ. Santo Domingo |
| SC-AES 84-CRSR-2-2519 | \$90,000 | Rhizobia and mycorrhizae to enhance BNF in cowpeas (9/15/84-9/30/87) | H. D. Skipper W. L. Ogle L. S. Wamochi Dept. Agron. & Soils Clemson Univ. Clemson, SC 29631 | S. O. Keya Univ. Nairobi Dept. Soil Science Nairobi, Kenya |
| TX-AES 84-CRSR-2-2521 | \$85,000 | Potential of increasing cowpea production in Haiti by inoculation (9/15/84-9/30/87) | R. W. Weaver (address earlier) | R. Graham CARDI, Barbados |
| WV-AES 84-CRSR-2-2518 | \$63,336 | Improvement of tropical pastures in Venezuela with nitrogen fixing legumes (9/5/84-12/31/87) | W. B. Bryan A. J. Sexstone Div. Plant & Soil Sci. W. V. Univ. Morgantown, WV 26506 | Thais de Estrada (UNELLEZ) Barinas/Guanare Efraim R. Velasquez (FUSAGRI) San Tome/Anaco |
| WI-AES 84-CRSR-2-2516 | \$90,000 | Selection for enhanced nitrogen fixation in common bean germplasm for Honduras (9/15/84-9/30/87) | F. A. Bliss (address earlier) | Drs. Rosas & Chang Escuela Agricola Panamericana, Hond. |

Fiscal Year 1985

PROGRAM I

| | | | | |
|--------------------------|----------|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| GA-AES 85-CRSR-2-2730 | \$83,000 | Nitrogen fixation of low-tannin sericea lespedeza on acid soils in Swaziland (9/15/85-9/30/88) | C. S. Hoveland Dept. of Agronomy Univ. of Georgia Athens, GA 30602 | P. D. Mkhathshwa Min. of Agric. Malkerns Res. Stn. P. O. Box 4 Malkerns, Swaziland |
|--------------------------|----------|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|

Attachment A (cont.)

Fiscal Year 1985--Program I (cont.)

| | | | | |
|-----------------------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| HI-NIFTAL 85-CRSR-2-2731 | \$87,500 | Production and conservation of fixed N in in tropical cropping systems: interaction between management and environment (9/15/85-9/30/88) | P. Singleton NIFTAL Project Dept. Agron. & Soil Sci. Univ. Hawaii P. O. Box 0 Paia, HI 96779 | Dr. C. R. Escano Crops Res. Dept. PCARRD Los Banos, Lag., Phil. |
| MI-AES 85-CRSR-2-2732 | \$83,000 | Improving the bean-Rhizobium symbiosis in Mexico (9/15/85-9/30/88) | F. B. Dazzo Microbiol. & Publ. Health Michigan State Univ. East Lansing, MI 48824 | J. S. Maya Flores Dep. de Microbiologia Inst. Tecnol. Reg. de Celaya, GTO Apd. Postal Num. 57 02800 Mexico DF |
| UT-AES 85-CRSR-2-2733 | \$87,000 | Biological nitrogen fixation in co-evolved Rhizobium and Medicago falcata ecotypes (9/1/85-8/31/88) | D. A. Johnson Crops Res. Lab Utah State Univ. Logan, UT 84322 | Dr. N. Mohammad Nat. Range Mgt. & Forage Program Nat. Agr. Res. Centre Islamabad, Pakistan |
| PROGRAM II | | | | |
| AZ-AES 86-CRSR-2-2745 | \$196,700 | Use of molecular biology to improve nitrogen fixation by bean rhizobia for Latin America (4/1/86-3/30/89) | I. A. Pepper & D. P. Bourque (address earlier) | Dr. Rafael Palacios CIFN-UNAM Apdo Postal No. 565-A Cuernavaca, Mor., Mex. |
| ND-AES 86-CRSR-2-2745 | \$138,000 | Genetically improved indigenous rhizobia for Latin American bean inoculants (4/1/86-3/31/89) | D. L. Berryhill (address earlier) | Blanca Hernandez Panama (address earlier) |
| <u>Fiscal Year 1986-87</u> | | | | |
| MT-AES | \$82,500 | Dryland legume/cereal rotations for Egypt and similar areas | J. R. Sims (address earlier) | A. S. Abdel-Ghaffar H. A. A. El-Attar (address earlier) |
| NY-AES | \$80,000 | Screening legumes for dry season survival in acid savanna tropics | D. L. Lathwell Dept. of Agronomy Cornell University Ithaca, NY 14853 | A. R. Suhel EMBRAPA/CPAC Caixa Postal 70.0023 73.300 Planaltina, DF Brazil |
| NC-AES | \$81,500 | Mycorrhiza and phosphorus effects on biological nitrogen fixation of tropical pastures and alley cropping systems | C. B. Davey Dept. of Soil Science N. C. State University Raleigh, NC 27695 | A. Salazar Estacion Experimental Yurimaguas Yurimaguas-Loreto Peru |
| SD-AEC | \$81,000 | Role of mycorrhizal fungi in nitrogen fixation in legume-maize intercropping | R. L. Todd Dept. of Microbiology S. D. State University Brookings, SD 57007 | A. C. Roy Institute of Agronomic Research Yaounde, Cameroon |
| WA-AEC | \$86,000 | Detection of Rhizobium in soil, rhizosphere and nodules by DNA probe | D. F. Bezdicek (address earlier) | I. M. Cakmakci (address earlier) |



United States
Department of
Agriculture

Cooperative
State Research
Service

Natural Resources,
Food and Social
Sciences

Washington, D.C.
20251

APR 11 1986

CSRS-SL-2962(a)

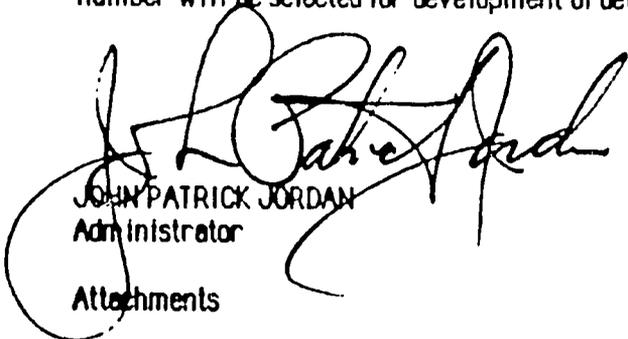
SUBJECT: Research on Factors Limiting Symbiotic Nitrogen Fixation for Crop
Production in Developing Countries--Request For Proposals

TO: Directors, State Agricultural Experiment Stations
Research Directors, Evans-Allen Programs
A-TR's, McIntire-Stennis Programs and
Other Interested Persons

In fiscal years 1976 through 1985, funds have been provided by an agreement between the Agency for International Development (AID) and the Cooperative State Research Services, (CSRS), U. S. Department of Agriculture to make grants on symbiotic nitrogen fixation research. Funds are anticipated in FY 1986 and FY 1987 for grants to be awarded for several research projects on, "Factors Limiting Symbiotic Nitrogen Fixation for Crop Production in Developing Countries." Preference will be given to proposals which employ a combination of biotechnological and applied or developmental research methodologies.

Guidelines are attached for preparation of preproposals to submit for peer review. If scientists at your institution who are conducting research in these areas are available and interested, it is requested they submit a three-page preproposal on research that would be done. These preproposals should be submitted through appropriate channels at your institution.

The preproposals must be received by CSRS not later than June 16, 1986. After their review, a limited number will be selected for development of detailed proposals.



JOHN PATRICK JORDAN
Administrator

Attachments

SPECIAL GRANTS FOR RESEARCH ON FACTORS LIMITING SYMBIOTIC NITROGEN FIXATION FOR CROP PRODUCTION IN DEVELOPING COUNTRIES

The Cooperative State Research Service (CSRS) plans to make a limited number of grants for research on Factors Limiting Symbiotic Nitrogen Fixation for Crop Production in Developing Countries (LDC) in fiscal years 1986 and 1987. This is a continuation of a program initiated in fiscal year 1976 and first announced in CSRS SL-2719, April 4, 1976.

Preproposals are invited that use cultivar-strain-soil interactions to improve the biological nitrogen fixation (BNF) capacity and yield of field-grown legume crops in developing countries. Preference will be given to proposals which employ a combination of biotechnological and applied or developmental research methodologies.

Grant preproposals/proposals should address research needs in some of the following areas:

1. Factors optimizing rhizobia and inoculation success.
2. Factors in the soil to enhance successful biological nitrogen fixation (BNF).
3. Factors in the plant that optimize nodulation and BNF.
4. Factors that optimize the use of BNF in cropping systems.

The preproposal, which has features of a proposal but in brief form, should address inoculation and BNF problems of crops grown in the developing countries. These crops include food legumes, forage legumes, and tree legumes. The tree legumes research should be addressed to their use in agro-forestry systems, for firewood, or for conservation of tropical soils. Intercropping of forage or food legumes with non-leguminous trees should also be considered. Investigations on soybeans and peanuts will not be funded.

Grant proposals shall include cooperative research with scientists in AID-supported countries. Without such linkages they will not be considered for funding. Direct linkages with scientists at national institutions and universities are preferred. A letter of intent to cooperate, from the LDC scientist, is required in the final full-length proposal. Some ideas for arranging a cooperative project proposal are contained in Appendix I, attached.

The preproposal should address in a condensed style the items listed in the format for proposals -- see Appendixes II to V. Be certain to include the name of the principal investigator who is to be contacted for additional details if required.

The preproposal/proposal should not exceed \$30,000 per year, including any indirect overhead costs, of which not over \$18,000 per year can be used for the United States component. All proposals should have a duration of three years or less. Since the research needs of the sponsoring agency (AID) are highly specific and the funds are quite limited, final details of grants may be negotiated.

A Selection Committee with representatives from USDA-CSRS, AID, USDA-ARS and other scientists will review all preproposals and proposals.

Submit brief preproposals (about 3 pages) as follows: Note, please show full address if sent by "fast" mail.

1. The original signature copy plus one photocopy and a letter of transmittal shall be sent to:

Dr. Charles M. Smith
Soil Scientist, CSRS
119 Justin Smith Morrill Building
U.S. Department of Agriculture
15th and Independence Avenue, S.W.
Washington, D.C. 20251

2. Eight (8) copies and the transmittal "cc" shall be sent to the Program Manager and addressed:

Dr. Gerald H. Elkan
Department of Microbiology
4515 Gardner Hall
North Carolina State University
Raleigh, North Carolina 27695-7615

ALL PREPROPOSALS MUST BE RECEIVED BY THE CLOSE OF BUSINESS, JUNE 16, 1986.

NOTE: Assuming sufficient high quality preproposals are received, they will be the basis for both FY 1986 and FY 1987 grants.

Following review of the preproposals, negotiations for the development of detailed proposals will be made with a limited number of investigators and their institutions.

Scientists having questions on technical aspects of the proposed grants should call Dr. Gerald Elkan, BNF/US AID Program Manager for CSRS (919) 737-3945 or Dr. Lloyd R. Frederick, AID (703) 235-1275.

Attachment

APPENDIX I

SUGGESTIONS ON PROPOSALS FOR COOPERATIVE STUDIES
WITH SCIENTISTS IN DEVELOPING COUNTRIES

1. Identify a problem on which you can make a contribution, and a developing country where the problem limits biological nitrogen fixation. Document the problem.
2. Contact a scientist or institution in the country of interest. Determine mutual interests in the proposed cooperative research. Scientists who were students in the United States could be good cooperators. Suggestions on possible cooperators may be obtained from national universities and ministries of agriculture; the International Agricultural Research Centers; and individuals such as Dr. Lloyd R. Frederick, Agency for International Development, S&T/AGR, Room 420 SA-18, Washington, DC 20523, telephone (703) 235-1275 and Dr. Deane F. Weber, Cell Culture and Nitrogen Fixation Laboratory, ARS, USDA, BARC-West, Beltsville, Maryland 20705, telephone (301) 344-3274/3612.
3. In the preproposal, the name, address, and telephone number of the potential cooperator(s); the nature of the contacts made and the nature of the cooperative work should be given.
4. In the fully developed proposals, it will be necessary to submit copies of correspondence with the cooperator that show willingness to cooperate, work distribution and financial arrangements--but the agreements should not be formalized until the proposal is selected for funding. Overseas cooperators should be listed as coprincipal investigators on the grant application (cover page) sheet, including their address and telephone number.
5. After the proposal is selected for funding, the agreement between institutions must be formalized before funds can be released.

APPENDIX II

APPLICATION PROCEDURES

1. Eligible Institutions

Grants may be made to Land-Grant Colleges and Universities, State Agricultural Experiment Stations, and to other institutions having a demonstratable capacity in food and agricultural research.

2. Preproposal and Proposal Submission

- A. In order to be considered for award, preproposals not exceeding three pages in length, excluding the title page, must be received by CSRS no later than the close of business on June 16, 1986.
- B. Preproposals should address in a condensed style the items listed in Format for Research Proposals. Items 2 (Objectives), 3 (Procedures), 4 (Justification), 9 (Personnel Support), and 10 (Financial Support) should receive emphasis. An extensive literature review, however, is not required for preproposals.
- C. All preproposals from an institution must be signed by a person authorized to act on behalf of the institution. The signature of the authorized person indicates that:
 - 1. The institution is committed to pursue the research activities described in the preproposal and in the proposal if selected for funding.
 - 2. The institution will commit all funds shown in the proposal budget to the research if the proposal is selected for funding.
- D. Research projects will be considered for funding only if they conform to the subject-matter guidelines.
- E. Estimated funding of the total project budget to come from CSRS Special Grant funds shown in preproposals cannot be exceeded when a fully developed proposal is requested, but funds from other sources may be increased in the full proposal if desired. Indirect overhead costs included in the total budget must be identified.
- F. Submit preproposals and proposals as follows:
 - 1. The original signature copy and a letter of transmittal shall be sent to Dr. C. B. Rumburg, Acting Deputy Administrator, Natural Resources, Food & Social Sciences, Room 119, Justin Morrill Building, Cooperative State Research Service, USDA, Washington, DC 20251.
 - 2. 8 copies shall be sent to the Program Manager, Dr. Gerald H. Elkan, Department of Microbiology, 4515 Gardner Hall, N. C. State University, Raleigh, NC 27695-7615.
- G. CSRS will invite a limited number of fully documented proposals based on the recommendation of a Selection Committee, which will evaluate preproposals. All copies of preproposals not selected will be returned to the institution or destroyed.
- H. Fully developed proposals invited by CSRS will be evaluated by peer scientists and by the Selection Committee and recommendations for funding will be made to the Administrator, Cooperative State Research Service.
- I. After grants are awarded, all copies of unfunded proposals will be returned to the originating institution or destroyed.

3. Budget and Reporting Requirements

The following items apply only to those proposals that are selected for funding:

- A. The grant will be awarded on the basis of all financial support, from any source, that is shown in the proposal budget.
- B. Annual financial report (Standard Form 269) will be required.
- C. An annual progress report not to exceed five pages will be required in addition to a shorter summary for insertion into a computerized research information service. Annual reports will be organized around the objectives and research timetable as specified in the project proposal.
- D. A comprehensive (performance and financial) final report must be submitted to CSRS within 90 days after the germination date of the grant.

4. Terms and Conditions

The Uniform Federal Assistance Regulations (7CFR Part 3015) applies to these grants. This document is available upon request to this office. Where applicable, this document can be obtained from your Agricultural Experiment Station Director.

FORMAT FOR RESEARCH PROPOSAL

1. **TITLE PAGE** (see Appendix IV)
 - A. **Title:** A brief, clear, specific designation of the subject of the research. Do not include such terms as "A Study of" or "A Detailed Analysis of." Names of overseas geographical regions or political subdivisions should be included if they are important to the subject of the research.
 - B. **Approved signatures of appropriate officials:** All proposals from a University, College, or Institution must be signed by the same authorized official(s).
2. **OBJECTIVES:** A clear, concise, complete and logically arranged statement of the specific aims of the research.
3. **PROCEDURES:** A statement of the essential working plans and methods to be used in attaining each of the stated objectives. Procedures should correspond to the objectives and follow the same order. Procedures should include items such as: The sampling plan, experimental design, and analyses anticipated.
4. **JUSTIFICATION:** This should describe: (1) the importance of the problem to the needs of developing countries, being sure to include estimates of the magnitude of the problem; (2) the importance of starting the work now; and (3) reasons for the work being performed in your particular institution.
5. **LITERATURE REVIEW:** A summary of pertinent publications with emphasis on their relationship to the research. Cite important and recent publications from other institutions, as well as your own institution. Citations should be accurate and complete.
6. **CURRENT RESEARCH:** Describe the relevancy of the proposed research to on-going and as yet unpublished research at your own and at other institutions. This section may be combined with Literature Review, if convenient to do so.
7. **FACILITIES AND EQUIPMENT:** The location of the work and the facilities and equipment needed and available should be clearly indicated. This section may be combined with section 3.--Procedures, but the combination must clearly show needed and available facilities and equipment.
8. **RESEARCH TIMETABLE:** Show all important research phases as a function of time.
9. **PERSONNEL SUPPORT:** Identify clearly all personnel who will be involved in the research. For each scientist involved include (1) an estimate of the time commitments necessary; (2) statement of training and research experience; (3) list of other research projects on which currently engaged; and (4) vitae of the principal investigator, senior associates, and other professional personnel should be provided to assist reviewers in evaluating the competence and experience of the project staff. This section should include curricula vitae of all key persons who will work on the project, whether or not Federal funds are sought for their support.
10. **FINANCIAL SUPPORT:** Show estimated annual costs by source of funds (grant and other sources) in conventional budget categories. Include indirect overhead costs where appropriate. (See Appendix V.)
11. **INSTITUTIONAL UNITS INVOLVED:** List each unit of the institution contributing essential services or facilities. The responsibilities of each should be clearly shown. If there is an advisory, or coordinating committee, for the project, list members by name, title, and affiliation.
12. **IMPACTS:** Estimate the magnitude of the scientific and/or socioeconomic benefits expected from the new knowledge or technology generated. Describe the users of the research results, how the results could be used, their potential impact on the problem defined in the project justification statement, the beneficiaries of the research results and the nature of the benefits received.

APPENDIX IV

TITLE PAGE FOR RESEARCH PROPOSAL
COOPERATIVE STATE RESEARCH SERVICE - USDA

For Consideration by _____
(Name of Program)

Title _____
(80 characters or less including spaces and punctuation; see instruction)

Proposed amount _____ Proposed Effective date _____ Proposed Duration months _____

Principal Investigator (PI) Name
Address of Principal Investigator:

Submitting Institution
Address of Submitting Institution:

Name, Co-Principal Investigator

Name, Co-Principal Investigator

If principal or co-principal investigator(s) have participated in previous SEA grants involving similar subject matter, give previous Special Grant No. _____

Make grant to _____
(Legal name of institution/organization to which grant should be made)

Internal Revenue Service No. _____ Congressional District No. _____

Endorsements:

Principal Investigator

Authorized Organizational Representative

Name _____

Title _____

Phone no. _____

Date _____

Signature _____

Other, if required by submitting organization:

Name _____

Title _____

Phone no. _____

Date _____

Signature _____

PROPOSAL BUDGET

| | | | | | | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|-----------------------------------|----------|------------------------------------------------------|----|
| ORGANIZATION AND ADDRESS | | | | DURATION PROPOSED | | S&E USE ONLY | |
| PRINCIPAL INVESTIGATOR(S)/PROJECT DIRECTOR(S) | | | | Months: _____ | | Months: _____ | |
| | | | | FUNDS REQUESTED BY PROPOSER | | FUNDS APPROVED BY S&E <i>(If different)</i> | |
| A. Salaries and Wages | | | | S&E FUNDED WORK MONTHS | | | |
| 1. No. of Senior Personnel | | | | Calendar | Academic | Summer | |
| a. ___ (Co)-PI(s)/PD(s) | | | | | | | \$ |
| b. ___ Senior Associates | | | | | | | \$ |
| 2. No. of Other Personnel (Non-Faculty) | | | | | | | |
| a. ___ Research Associates-Postdoctorate | | | | | | | |
| b. ___ Other Professionals | | | | | | | |
| c. ___ Graduate Students | | | | | | | |
| d. ___ Pre-Baccalaureate Students | | | | | | | |
| e. ___ Secretarial-Clerical | | | | | | | |
| f. ___ Technical, Shop, and Other | | | | | | | |
| Total Salaries and Wages ▶ | | | | | | | |
| B. Fringe Benefits (If charged as Direct Costs) | | | | | | | |
| C. Total Salaries, Wages, and Fringe Benefits (A plus B) ▶ | | | | | | | |
| D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.) | | | | | | | |
| E. Materials and Supplies | | | | | | | |
| F. Travel | | | | | | | |
| 1. Domestic (Including Canada) | | | | | | | |
| 2. Foreign (List destination and amount for each trip.) | | | | | | | |
| G. Publication Costs/Page Charges | | | | | | | |
| H. Computer (ADPE) Costs | | | | | | | |
| I. All Other Direct Costs (Attach supporting data. List items and dollar amounts. Details of subcontracts, including work statements and budget, should be explained in full in proposal.) | | | | | | | |
| J. Total Direct Costs (C through I) ▶ | | | | | | | |
| K. Indirect Costs (Specify rate(s) and base(s) for on/off campus activity. Where both are involved, identify itemized costs included in on/off campus bases.) | | | | | | | |
| L. Total Direct and Indirect Costs (J plus K) ▶ | | | | | | | |
| M. Less Residual Funds (If applicable) ▶ | | | | | | | |
| N. TOTAL AMOUNT of this REQUEST (L minus M) ▶ | | | | \$ | | \$ | |
| O. COST SHARING ▶ | | | | \$ | | | |

NOTE: Signatures required only for Revised Budget

This is Revision No. ▶

| | | |
|---------------------------------------------------|--------------------------|---------------------|
| <small>NAME AND TITLE (type or print)</small> | <small>SIGNATURE</small> | <small>DATE</small> |
| PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR | | |
| AUTHORIZED ORGANIZATIONAL REPRESENTATIVE | | |

Attachment D
 REVIEWER'S SCORING FORM

USDA/USAID SYMBIOTIC NITROGEN FIXATION:
 STUDIES OF FACTORS LIMITING N-FIXATION FOR LDC CROP PRODUCTION

Program Objectives:

Research contracts will be awarded to scientists experienced in working with biological nitrogen fixation and rhizobia-legume systems to conduct research which will (1) identify and examine those factors that limit optimum BNF in tropical and sub-tropical agriculture, (2) develop ways to overcome these limiting factors, and (3) devise new and improved ways to improve BNF technology to LDC small farmers.

Project Identification # _____

Project Title _____

Name and Address of PI _____

| A. Selection Criteria: | Score | Comments |
|-----------------------------------------------------------------------------------------------------|--------------|----------|
| 1) Overall scientific & technological quality of proposal considering the program objectives | (30 pts max) | |
| 2) Research competence of the PI(s), research team and support personnel and adequacy of facilities | (20 pts max) | |
| 3) Justification of support requested in relation to objectives and procedures | (30 pts max) | |
| 4) Potential importance of project to the specific LDC | (20 pts max) | |

See reverse side



United States
Department of
Agriculture

Cooperative
State Research
Service

Office of the
Administrator

Washington, D. C.
20250

Department of Microbiology
4505 Gardner Hall
N. C. State University
Raleigh, NC 27695
(Phone 919/737-3945)

This acknowledges receipt of the following preproposal(s) submitted for review in the Special Grants for Research on Factors Limiting Symbiotic Nitrogen Fixation for Crop Production in Developing Countries:

These preproposals are being reviewed by a Selection Committee composed of representatives of USAID and USDA-SEA/CR. As stated in CSRS-SL-2962(a), negotiations for the development of detailed proposals will be made with a limited number of institutions and investigators. Those investigators selected to develop detailed proposals will be informed in the very near future.

Sincerely,

A handwritten signature in cursive script that reads "Gerald H. Elkan".

Gerald H. Elkan
Program Manager, USDA-CSRS-AID
BNF Program (Limiting Factors Project)

GHE:pb



United States
Department of
Agriculture

Cooperative
State Research
Service

Office of the
Administrator

Washington, D.C.
20250

Director

....
....
....

Dear Director

In response to CSRS-SL-2962(a) dated April 11, 1986, Subject:
Research on Factors Limiting Symbiotic Nitrogen Fixation for Crop
Production in Developing Countries, 36 pre-proposals were received
by CSRS. The pre-proposals were evaluated by a selection committee
as provided by an agreement between the Agency for International
Development (AID) and CSRS, U. S. Department of Agriculture. Based
on the evaluation, we have requested that detailed proposals be
developed on 11 of the pre-proposals. The following pre-proposal
was not selected for further development and all copies will be
destroyed:

Should you have any questions or desire any further information,
please contact Dr. Gerald H. Elkan, Program Manager, CSRS-AID,
Nitrogen Fixation Program, Department of Microbiology, 4515 Gardner
Hall, N. C. State University, Raleigh, NC 27695-7615 (telephone
919/737-3945).

Sincerely,

CHARLES M. SMITH
Soil Scientist

cc: P.I.

Attachment B (cont.)



United States
Department of
Agriculture

Cooperative
State Research
Service

Natural Resources,
Food and Social
Sciences

Washington, D.C.
20251

Director ...

...
...
...

Dear Director ...

This is in confirmation of a telephone call from Dr. Gerald Elkan, Program Manager, CSRS-AID BNF Program, to you or the principal investigator requesting the submission of a detailed proposal for research on Factors Limiting Symbiotic Nitrogen Fixation for LDC Crop Production. The proposal is to be a consolidation and elaboration of the research proposed in the following pre-proposal:

...

CSRS has requested detailed proposals on 11 of the 36 pre-proposals which were submitted.

In preparation of the detailed proposal please follow the Federal Register announcement regarding the format and the budget statement for Special Grant proposals. We have enclosed a copy of both, the Federal Register and the Grant Application Kit.

Please prepare 12 copies of the proposal and submit as follows:

10 copies to:

Dr. Gerald H. Elkan
Program Manager, CSRS-AID
Nitrogen Fixation Program
Department of Microbiology
Box 7615
N. C. State University
Raleigh, NC 27695-7615

Original signature copy and 1 copy to:

Dr. Charles Smith
Soil Scientist
CSRS-USDA
119 Justin Morrill Building
Washington, DC 20251

All proposals should be received no later than 16 September 1986.

Sincerely,

CHARLES M. SMITH
Soil Scientist

Enclosures

cc: P.I.



United States
Department of
Agriculture

Cooperative
State Research
Service

Natural Resources,
Food and Social
Sciences

Washington, D.C.
20251

Director ...

...
...
...

Dear Director ...

The proposal listed below was submitted for possible funding under the CSRS-AID BNF program titled, "Research on Factors Limiting Symbiotic Nitrogen Fixation for Crop Production in Developing Countries":

...

All proposals submitted were evaluated by independent peer scientists and a selection committee as provided by an agreement between the Agency for International Development (AID) and CSRS, U.S. Department of Agriculture. Based on the evaluation information and the decision of this committee, the project named above was not funded and all copies of the proposal have been destroyed.

The Program Manager, Dr. Gerald H. Elkan (919) 737-3945, will answer questions about the proposal upon request.

Very truly yours,

CHARLES M. SMITH
Soil Scientist

cc: P.I.

Attachment C

PREPROPOSALS RECEIVED 1986

- 86-1 G. W. Thomas, Dept. of Agronomy, N-122 Agricultural Science Building-North, University of Kentucky, Lexington, KY 40546-0091 (606/257-7310). MAXIMIZING NITROGEN FIXATION BY STYLOSANTHIS IN MOUNTAINOUS PASTURES OF THE DOMINICAN REPUBLIC. (3 yr--\$28,000)
- 86-2 Edward C. F. Benya, Director of Research, SOCOPO, The Jesuit Residence of Jesuit High School, 4133 Banks St., New Orleans, LA 70119. NITROGEN CYCLING IN SINGLE AND MULTI STRATA TROPICAL AGROFORESTRY SYSTEMS. (2 yr--\$24,796) (cooperating with Brazil)
- 86-3 Judy D. Wall, Biochemistry Dept., 117 Schweitzer Hall, UMC, Columbia, MO 65211 (314/882-4845). BACTEROID AMMONIUM TRANSPORT IN NODULES OF PHASEOLUS VULGARIS. (3 yr--\$52,272) (Institutional rep.: John P. McCormick, Asso. Grad. Dean for Res., 314 Jesse Hall, Univ. of Missouri-Columbia, Columbia, MO 65211, 314/882-6311) (cooperating with Paraguay)
- 86-4 K. T. Shanmugam, Dept. of Microbiology and Cell Science, Univ. of Florida, Gainesville, FL 32611. (904/392-2490). CHARACTERIZATION OF COLORED COMPOUND(S) FROM DARK NODULES OF COWPEA. (2 yr--\$59,496) (Institutional rep.: Dr. Robert C. Kramer, Director of Sponsored Programs and Development, Univ. of Florida, Gainesville, FL 32611) (cooperating with Jamaica)
- 86-5 L. C. Davis, Dept. of Biochemistry, Willard Hall, Kansas State Univ., Manhattan, KS 66506 (913/532-6124). RHIZOBIAL GENETIC PROCESSES MONITORED BY MOLECULAR MARKING. (3 yr--\$86,770) (Institutional rep.: John A. Moore, Jr., Controller, Kansas State Univ., Manhattan, KS 66506) (cooperating with Mexico)
- *86-6 Robert L. Todd, Dept. of Microbiology, South Dakota State Univ., Brookings, SD 57007 (605/688-4119). ROLE OF MYCORRHIZAL FUNGI IN NITROGEN FIXATION IN LEGUME-MAIZE INTERCROPPING. (3 yr--\$88,657) (Inst. rep.: Raymond A. Moore, Dir. of Agric. Expt. Sta., South Dakota State Univ., Brookings, SD 57007) (cooperating with Cameroon)
- 86-7 Eduardo C. Schroder, Dept. of Agronomy & Soils, College of Agric. Sci., Univ. of Puerto Rico, Mayaguez, PR 00708 (809/832-3980). USE OF WATER HYACINTH TO IMPROVE CANOPY CO₂ AND N₂ FIXATION IN LEGUMES. (3 yr--\$90,000) (Inst. rep.: Lii Jang Liu, Coordinator of Internat. Programs, University of Puerto Rico, Mayaguez, PR 00708) (cooperating with India)
- 86-8 Eduardo C. Schroder (same as above). LEUCAENA AS A SOURCE OF N, GREEN MANURE AND WOOD FOR SMALL FARMS IN ECUADOR. (3 yr--\$90,000). (Inst. rep.: Same as above) (cooperating with Ecuador)
- 86-9 Eduardo C. Schroder (same as above). INOCULATION AND ADAPTATION OF FAST GROWING NITROGEN FIXING TREES IN SAINT LUCIA. (3 yr--\$90,000). (Inst. rep.: Same as above) (cooperating with St. Lucia)
- 86-10 Dyremples Marsh, Lincoln University, Jefferson City, MO 65101 (314/751-2821). YIELD POTENTIAL OF DRY BEAN (PHASEOLUS VULGARIS) AND COWPEA (VIGNA UNGUICULATA) BY AMENDING SOIL FACTORS LIMITING BIOLOGICAL NITROGEN FIXATION. (3 yr--\$90,000). (Inst. rep.: John Chavis, Dean of the Univ., Lincoln Univ., Jefferson City, MO 65101) (cooperating with West Indies)
- 86-11 E. W. Triplett, Dept. of Plant Pathology, Univ. of California, Riverside, CA 92521 (714/787-5308). DEVELOPMENT OF SUPERIOR, COMPETITIVE BRADYRHIZOBIUM STRAINS FOR COWPEA IN JAMAICA. (3 yr--\$90,000) (Inst. rep.: Leland M. Shannon, Dean of Graduate Division and Research Development, Univ. of California, Riverside, CA 92521) (cooperating with Jamaica)
- *86-12 D. J. Lathwell, Dept. of Agronomy, Cornell Univ., Ithaca, NY 14853 (607/255-1722). SCREENING LEGUMES FOR DRY SEASON SURVIVAL IN ACID SAVANNA TROPICS. (3 yr--\$88,545) (Inst. rep.: Donna Jean Garrett, Office of Sponsored Programs, Cornell Univ., Ithaca, NY 14853-2801) (cooperating with Brazil and Zambia)
- *86-13 D. F. Bezdicek, Dept. of Agron. & Soils, Washington State Univ., Pullman, WA 99164-6420 (509/335-3644). DETECTION OF RHIZOBIUM IN SOIL, RHIZOSPHERE AND NODULES BY DNA PROBE. (3 yr--\$90,000) (Inst. rep.: C. J. Nyman, Dean of Graduate School and Vice Provost for Research, Washington State Univ., Pullman, WA 99164-1030) (cooperating with Turkey)
- 86-14 D. F. Bezdicek (same as above). CLONING OF B. THURINGIENSIS GENE INTO R. LEGUMINOSARUM FOR CONTROL OF SITONA WEEVIL. (3 yr--\$90,000). (Inst. rep.: Same as before) (cooperating with Turkey)
- *86-15 C. B. Davey, Dept. of Soil Science, N. C. State Univ., Box 7619, Raleigh, NC 27695-7619 (919/737-2655). MYCORRHIZA AND P EFFECTS ON BNF IN TROPICAL PASTURE AND ALLEY-CROPPING SYSTEMS. (3 yr--\$89,950) (Inst. rep.: D. F. Bateman, Director, N. C. Agric. Res. Serv., Box 7601, Raleigh, NC 27695) (cooperating with Peru)
- *86-16 T. J. Smyth, Dept. of Soil Science, N. C. State Univ., Raleigh, NC 27695-7619 (919/737-2655). SELECTION AND MANAGEMENT OF LEGUME GREEN MANURE GERMPASM IN THE AMAZON. (3 yr--\$89,750) (Inst. rep.: Same as above) (cooperating with Brazil)
- 86-17 D. B. Focht, Soil and Environmental Sciences, Univ. of California, Riverside, CA 92521. SURVIVAL IN SOIL OF HIGHLY COMPETITIVE COWPEA RHIZOBIUM STRAIN P132. (4 yr--\$90,000) (cooperating with Panama)
- *86-18 J. R. Sims, Plant and Soil Science Dept., Montana State Univ., Bozeman, MT 59717-0002. DRYLAND LEGUME/CEREAL ROTATIONS FOR EGYPT AND SIMILAR AREAS. (3 yr--\$90,000) (Inst. rep.: A. Hovin, Associate Director, Montana State Univ., Bozeman, MT 59717) (cooperating with Egypt)
- 86-19 T. M. Davis, Plant Science Dept., Nesmith Hall, Univ. of New Hampshire, Durham, NH 03824 (603/862-3217). MOLECULAR GENETICS OF THE CHICKPEA-RHIZOBIUM SYMBIOSIS. (3 yr--\$90,000). (Inst. rep.: Lennard A. Fisk, Vice President for Res. and Financial Affairs) (cooperating with India)
- *86-20 Padma Somasegaran, Univ. of Hawaii Nifal Project, P.O. Box O, Paia, HI 96779 (808/575-9568). IMPROVING N-FIXATION AND HOST-RANGE OF COMPETITIVE RHIZOBIUM FROM TREE LEGUMES. (2 yr--\$89,981) (Inst. rep.: E. E. Bohloul, Nifal Director) (cooperating with Malaysia)
- 86-21 M. H. Scholla/B. J. Taiter, Dept. of Biology, Memphis State Univ., Memphis, TN 38152 (901/454-2985). CHARACTERIZATION & SIGNIFICANCE OF CYTOKININ PRODUCTION BY RHIZOBIUM. (3 yr--\$90,000). (Inst. rep.: E. P. Segner, Jr., Assoc. Vice-President for Research) (cooperating with the Philippines)

Attachment C (cont.)

-2-

- 86-22 D. N. Munns, Dept. of LAWR, Univ. of California, Davis, CA 95616 (916/752-1823/752-1407). N-FIXATION AND SUB-SOIL NUTRIENT ACCUMULATION BY LEUCAENA LEUCOCEPHALA. (3 yr--\$90,000) (Inst. rep.: B. Webster, Asso. Dean, Office of Research) (cooperating with Zimbabwe)
- 86-23 R. W. Weaver, Dept. of Soil & Crop Sciences, Texas A&M Univ., College Station, TX 77843 (409/845-8322). INHERENT LIMITATIONS TO N₂-FIXATION IN COWPEA AND ENHANCEMENT BY USE OF STARTER N. (3 yr--\$69,976). (Inst. rep.: Dr. Neville P. Clarke, Director, Texas Agric. Exp. Sta.) (cooperating with West Indies)
- 86-24 J. C. Miller, Jr., Dept. of Horticultural Sciences, Texas A&M Univ., College Station, TX 77843. BREEDING LEGUMES FOR ENHANCED NITROGEN FIXATION--AN ALTERNATIVE APPROACH USING ASSOCIATED PLANT TRAITS. (3 yr--\$54,000) (Inst. rep.: Neville P. Clarke, Director) (cooperating with Taiwan and Sri Lanka)
- 86-25 M. I. H. Aleem and T. C. Gray, Dept. of Microbiology, University of Kentucky, Lexington, KY 40506 (606/257-4630). ENHANCED N₂-FIXATION BY RHIZOBIUM IN SALINE-SODIC SOILS OF PAKISTAN. (3 yr--\$90,000) (Inst. rep.: J. Y. McDonald, Executive Director, Univ. of Kentucky Research Foundation, Kinkeade Hall) (cooperating with Pakistan)
- 86-26 D. H. Hubbell, Dept. of Soil Science, Univ. of Florida, Gainesville, FL 32611 (904/392-1951). ALTERNATE METHODOLOGIES FOR BEAN INOCULATION IN COSTA RICA. (3 yr--\$90,000) (Inst. rep.: Donald R. Price, Vice President for Research, Division of Sponsored Research) (cooperating with Costa Rica)
- 86-27 D. H. Hubbell (same as above). INTEGRATED EXTENSION/RESEARCH/TEACHING PROGRAM FOR LEGUME INOCULATION IN HONDURAS. (3 yr--\$90,000) (Inst. rep.: Same as above) (cooperating with Honduras)
- 86-28 Jimmy J. Street, Dept. of Soil Science, Univ. of Florida, Gainesville, FL 32611 (904/392-1951). MICRONUTRIENTS LIMITING BEAN PRODUCTION IN SOILS OF COSTA RICA. (Inst. rep.: Same as above) (cooperating with COSTA RICA)
- 86-29 W. D. Pitman, Univ. of Florida, Agric. Research Center, Ona, FL 33865 (813/735-1314). TROPICAL FORAGE LEGUME SURVIVAL: PLANT SPECIES, RHIZOBIUM INOCULATION, NUTRIENTS. (3 yr--\$90,000 ?) (Inst. rep.: Same as above) (cooperating with Venezuela)
- 86-30 M. B. McDonald, Jr., Dept. of Agronomy, The Ohio State Univ., Columbus, OH 43210 (614/422-2001). ROOT COLONIZATION EFFICACY BY RHIZOBIUM PHASEOLI AS INFLUENCED BY SEED QUALITY. (3 yr--\$90,000). (Inst. rep.: Richard L. Wright, Deputy Director for Development, The Ohio State University Research Foundation) (cooperating with Dominican Republic)
- 86-31 Alan J. Sexstone, Div. of Plant & Soil Sciences, West Virginia Univ., Box 6108, Morgantown, WV 26506 (306/293-3911). INTERCROPPING MAIZE AND COWPEAS IN SEMI ARID KENYA. (2 yr--\$35,760). (Inst. rep.: Neil S. Bucklew, Associate V.P. for Academic Affairs & Research) (cooperating with Kenya)
- 86-32 Alan J. Sexstone, Div. of Plant & Soil Sciences, West Virginia Univ., Box 6108, Morgantown, WV 26506 (304/293-3911). IMPROVEMENT OF TROPICAL PASTURES IN VENEZUELA WITH NITROGEN FIXING LEGUMES--EXPANSION. (3 yr--\$62,855). (Inst. rep.: Neil S. Bucklew, President)
- 86-33 Jo Handelsman, Dept. of Plant Pathology, Univ. of Wisconsin, Madison, WI 53706 (608/263-8783). CONSTRUCTION OF HIGHLY COMPETITIVE RHIZOBIUM STRAINS FOR THE U.S. AND HONDURAS. (3 yr--\$86,115). (Inst. rep.: Robert Erickson, 446 Peterson Building)
- * 86-34 Carl J. Rosen, Dept. of Soil Science, Univ. of Minnesota, St. Paul, MN 55108 (612/625-8114). NITROGEN FIXATION AND DROUGHT TOLERANCE IN INTERSPECIFIC PHASEOLUS GENOTYPES. (3 yr--\$90,000). (Inst. rep.: Marilyn Surbey, Asst. Director) (cooperating with Honduras)
- 86-35 H. D. Skipper, Dept. of Agronomy & Soils, Clemson Univ., Clemson, SC 29634-0359 (803/656-3525). CHARACTERISTICS OF RHIZOBIA REQUIRED TO IMPROVE BNF IN COWPEAS. (3 yr--\$90,000). (Inst. rep.: Alden L. McCracken, Asst. Vice-President, Budgets & Planning) (cooperating with Kenya)
- * 86-36 George S. Abawi, Dept. of Plant Pathology, NYS Agric. Exp. Sta., Cornell Univ., Geneva, NY 14456 (315/787-2374). EFFECTS OF ROOT PATHOGENS ON EXPRESSION OF NITROGEN FIXATION POTENTIAL IN BEANS. (3 yr--\$89,142). (cooperating with CIAT, Colombia and CIPA, Peru)

*Selected for full proposal.

Attachment E

USDA-SEA/CR-AID BNF PROJECT P.I. MAILING LIST

Backman, Paul A., Dept. of Plant Pathology, Auburn Univ., Auburn, AL 36830
Baltensperger, David O., Dept. of Agronomy, Univ. of Florida, Gainesville, FL 32611
Berryhill, D. L., Dept. of Microbiology, North Dakota State Univ., Fargo, ND 58102
Bezdicek, D. F., Dept. of Agronomy, Washington State Univ., Pullman, WA 99164
Bliss, Fredrick A., Dept. of Horticulture, Univ. of Wisconsin, Madison, WI 53706
Bohlool, B. B., Dept. of Microbiology, Univ. of Hawaii, Honolulu, HI
Bourque, D. P., Dept. of Biochemistry, Univ. of Arizona, Tucson, AZ 85721
Bouton, J. H., Agronomy Dept., Univ. of Georgia, Athens, GA 30602
Bryan, William B., Div. of Plant and Soil Science, West Virginia Univ., Morgantown, WV 26506
Davey, Charles B., Dept. of Soil Science, N. C. State Univ., Raleigh, NC 27695
Dazzo, F. B., Microbiology & Public Health, Michigan State Univ., East Lansing, MI 48824
Elkan, Gerald H., Dept. of Microbiology, N. C. State Univ., Raleigh, NC 27695
Focht, Dennis D., Dept. of Soil and Environmental Science, Univ. of California, Riverside, CA 92521
Foster, Ken W., Dept. of Agronomy and Range Science, Univ. of California, Davis, CA 95616
Graham, P. H., Dept. of Soil Science, Univ. of Minnesota, St. Paul, MN 55108
Gross, H. D., Dept. of Crop Science, N. C. State Univ., Raleigh, NC 27695
Ham, G. E., Dept. of Soil Science, Univ. of Minnesota, St. Paul, MN 55101
Hannaway, David B., Crop Science Dept., Oregon State Univ., Corvallis, OR 97331
Hoveland, Carl S., Dept. of Agronomy, Univ. of Georgia, Athens, GA 30602
Hubbell, David H., Dept. of Soil Science, Univ. of Florida, Gainesville, FL 32611
Johnson, D. A., Crops Research Lab., Utah State Univ., Logan, UT 84322
Lathwell, D. L., Dept. of Agronomy, Cornell Univ., Ithaca, NY 14853
Lindemann, W. C., Dept. of Agronomy, New Mexico State Univ., Las Cruces, NM 88005
Lockerman, R. H., Dept. of Plant and Soil Science, Montana State Univ., Bozeman, MT 59717
Loynachan, T. E., Dept. of Agronomy, Iowa State Univ., Ames, Iowa 50011
Marcarian, V., Dept. of Agronomy, Univ. of Arizona, Tucson, AZ 85721
Miller, J. C., Jr., Texas A&M Univ., Dept. of Horticultural Science, College Station, TX 77843
Miller, Robert H., Dept. of Soil Science, N. C. State Univ., Raleigh, NC 27695
Munns, Donald H., Dept. of Land Resources, Univ. of California, Davis, CA 95616
Murphy, William, Central Oregon Agric. Expt. Sta., Reomond, OR 97756
Neal, J. L., Dept. of Biology, VPI&SU, Blacksburg, VA 24061
Pepper, I. L., Dept. of Soils, Water & Eng., Univ. of Arizona, Tucson, AZ 85721
Peterson, Harold L., Dept. of Agronomy, Mississippi State Univ., State College, MS 39762
Phillips, D. A., Dept. of Agronomy and Range Science, Univ. of California, Davis, CA 95616
Qualset, C. O., Dept. of Agronomy, Univ. of California, Davis, CA 95616
Roskoski, Joan P., NifTAL Project, Univ. of Hawaii, P.O. Box 0, Paia, HI 96779
Schenck, N. C., Plant Pathology Dept., Univ. of Florida, Gainesville, FL 32611
Schmidt, E. L., Dept. of Soil Science, Univ. of Minnesota, St. Paul, MN 55101
Schroder, E. C., Dept. of Agronomy & Soils, Univ. of Puerto Rico, Mayaguez, PR 00708
Scott, R. Thomas, Agronomy Dept., Cornell Univ., Ithaca, NY 14850
Scudder, W. T., Fla. Agric. Expt. Sta., Dept. of Horticulture, Sanford, FL 32771
Setter, T. L., Dept. of Agronomy, Cornell Univ., Ithaca, NY 14850
Sims, James R., Dept. of Plant and Soil Science, Montana State Univ., Bozeman, MT 59717
Singleton, P., NifTAL Project, Dept. of Agronomy and Soil Science, Univ. of Hawaii, P.O. Box 0, Paia, HI 96779
Skipper, H. D., Dept. of Agronomy & Soils, Clemson Univ., Clemson, SC 29631
Smith, M. Scott, Dept. of Agronomy, Univ. of Kentucky, Lexington, KY 40546
Smith, R. Stewart, The Nitragin Co., Inc., 3101 W. Custer Ave., Milwaukee, WI 53209
Todd, R. L., Dept. of Microbiology, South Dakota State Univ., Brookings, SD 57007
Weaver, R. W., Dept. of Soil & Crop Science, Texas A&M Univ., College Station, TX 77843
Webster, Barbara D., Dept. of Agronomy, Univ. of California, Davis, CA 95616
Wilson, David O., Georgia Agric. Expt. Sta., Dept. of Agronomy, Experiment, GA 30212
Wollum, A. G., II., Dept. of Soil Science, N. C. State Univ., Raleigh, NC 27695
Wynne, J. C., Dept. of Crop Science, N. C. State Univ., Raleigh, NC 27695

Attachment F

USDA-SEA/CR-AID BNF PROJECT FOREIGN PRINCIPAL INVESTIGATORS AND COOPERATORS

Abdel-Ghaffar, A. S.
(J. R. Sims, MT; R. L. Lockerman, MT)
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Abilay, R.
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Agboola, A. A. A.
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Trinidad, W.I.

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Cruz, Reynaldo Dela
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Daudi, A.
(D. D. Baltensperger, FL)
Nematologist, Malawi

Diaz-I., R. Mancilla y
(W. C. Lindemann, NM)
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Mexico 6, DF, Mex.

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Nuno Maria de Sousa Costa
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Barinas/Guanare

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Gibbons, R. W.
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Graham, Richard
(R. W. Weaver, TX)
CARDI
Barbados

Grant, Thomas
(M. S. Smith, KY)
AID
Santiago, Dom. Republic

Gunatilaka, M. K.
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Peradeniya, Sri Lanka
(Currently at VPI&SU)

Harndoun, A.
(T. E. Loynachan, IA)
Agric. Res. Corp.
Wad Medani, Sudan

Hernandez, Blanca de
(D. D. Focht, CA)
Univ. of Panama
Panama, Rep. of Panama

Hilali, Mr.
(E. L. Schmidt, MN)
(Dr. Bekkali Abdallah, Director)
Institut Agronomique et
Veterinaire Hassan II
Rabat, Morocco

Jaurequi, Pedro
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Dept. of Soil Science
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FUSAGRI
Cantaura
Edo Anzoategui, Venezuela

Mkhatshwa, P. D.
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Mohammad, Noor
(D. A. Johnson, Utah State Univ.)
National Range Management and
Forage Program
National Agric. Research Centre
Islamabad, Pakistan

Msiska, H. D. C.
(D. D. Baltensperger, FL)
Forage Agronomist, Malawi

Mukhtar, N. O.
(T. E. Loynachan, IA)
Agric. Res. Corp.
Wad Medani, Sudan

Munevar M., Fernando
(A. G. Wollum, NC)
Ingeniero Agronomo
Universidad Nac. d Colombia
Colombia

Musa, M. M.
(T. E. Loynachan, IA)
Agric. Res. Corp.
Wad Medani, Sudan

Obando, Raul
(W. C. Lindemann, NM)
INIA-CIAN
Matamoros, Coah., Mexico

Odu, C. T. I.
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D. L. Berryhill, ND)
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Centr. Agric. Sta.
Mon Repos, Guyana, S.A.

Pineda, C.
(F. A. Bliss, WI)
Escuela Agric. Panamericana
Tegucigalpa, Hond.

Pradhan, D. R.
(J. H. Bouton, GA)
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Kathmandu, Nepal

Prophette, E. H.
(J. C. Miller, TX)
Ministry of Agriculture
DARNDR-SERA
Damien, PAP, Haiti

Rajapakse, S.
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(W. Murphy, OR)
Carillanca Expt. Station
Temico, Chile

Attachment G

USDA-SEA/CR-AID BNF PROJECT LDC COUNTRIES REPRESENTED
(1976-1986)

AFRICA (10)

Cameroon
Egypt
Kenya
Malawi
Morocco
Nigeria
Senegal
Sudan
Swaziland
Tunisia

ASIA (8)

India
Malaysia
Nepal
Pakistan
Philippines
Sri Lanka
Thailand
Turkey

CARIBBEAN (4)

Barbados
Dominican Republic
Haiti
Trinidad

CENTRAL AMERICA (5)

Costa Rica
El Salvador
Honduras
Mexico
Panama

SOUTH AMERICA (7)

Brazil
Chile
Colombia
Ecuador
Guyana
Peru
Venezuela

Attachment H

USDA-SEA/CR-AID BNF PROJECT INSTITUTIONS WITH GRANTS
(1976-1986)

| | |
|--------------------------------------|-----------------------------------------|
| Arizona, University of (4) | New Mexico State University (2) |
| Auburn University (1) | Nitragin Company (1) |
| California, Univ. of (Davis) (5) | North Carolina State University (8) |
| California, Univ. of (Riverside) (4) | North Dakota State University (2) |
| Clemson University (1) | Ohio State University (1) |
| Cornell University (4) | Oregon State University (1) |
| Florida, University of (5) | Puerto Rico, University of (1) |
| Georgia, University of (5) | South Dakota State University (1) |
| Hawaii, University of (5) | Texas A&M University (8) |
| Iowa State University (1) | Utah State University (1) |
| Kentucky, University of (1) | Vermont, University of (1) |
| Michigan State University (1) | Virginia Polytechnic Institute & SU (1) |
| Minnesota, University of (5) | Washington State University (4) |
| Montana State University (4) | West Virginia, University of (2) |
| Mississippi State University (2) | Wisconsin, University of (3) |

Attachment I
Publications Resulting from USDA/CSRS-AID BNF Project

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Attachment J

GRADUATE STUDENTS SUPPORTED ON USDA-SEA/CSRS-AID PROGRAM FUNDS

| <u>Name</u> | <u>Degree</u> | <u>University</u> |
|------------------------------|----------------|---------------------|
| Aarons, Sharon (Jamaica) | -- | Univ. Minnesota |
| Amara, Dennis (Sierra Leone) | Ph.D., 1981 | Ohio State Univ. |
| Andrews, Ann M. (Honduras) | Ph.D.-in prog. | Univ. Florida |
| Arrendell, Susan | Ph.D.-in prog. | N. C. State Univ. |
| Ball, S. T. | M.S., 1982 | " |
| Barbour, M. W. | M.S., 1985 | " |
| Bardoll, Anne | M.S., 1983 | Univ. Florida |
| Bartolome, Lisa (Philip.) | Ph.D.-in prog. | " |
| Boonkerd, Nantakorn (Thai.) | Ph.D., 1981 | Texas A&M Univ. |
| Byalebeka, J. B. (Uganda) | Ph.D., 1986 | N. C. State Univ. |
| Carreno, Malgre (Venezuela) | M.S.-in prog. | West Va. Univ. |
| Chong, Kewi (Malaysia) | Ph.D., 1983 | N. C. State Univ. |
| Crawford, Steven L. | M.S., 1981 | N. D. State Univ. |
| Doetskott, Dawn | -- | " |
| Duroi, Elio (Honduras) | -- | N. M. State Univ. |
| Ellis, William R. | M.D., 1979 | Wash. State Univ. |
| Fernandez, G. (Sri Lanka) | M.S.-in prog. | Texas A&M Univ. |
| Futch, Margaret G. | M.S., 1979 | " |
| Hadad, Mohammad | M.S., 1981 | Iowa State Univ. |
| Hernandez, Blanca | Ph.D.-in prog. | U. Calif.-Riverside |
| Isleib, T. G. | M.S., 1979 | N. C. State Univ. |
| Johnson, Erik | M.S.-in prog. | Univ. Georgia |
| Kisha, Theodore J. | M.S., 1982 | Montana State Univ. |
| La Favre, Jeffrey | Ph.D.-in prog. | U. Calif.-Riverside |
| McIntyre, Gail | M.S.-in prog. | N. C. State Univ. |
| McQuinn, Stanley D. | M.S., 1980 | Texas A&M Univ. |
| Menendez, Oscar | M.A., 1982 | Univ. Florida |
| Mohjadi, Wahid | Ph.D., 1981 | Ohio State Univ. |
| O'Hair, Stephen K. | Ph.D., 1980 | Texas A&M Univ. |
| Oliveira, Luiz de (Brazil) | -- | Univ. Minnesota |
| Osman, A. K. (Sudan) | M.S., 1983 | N. C. State Univ. |
| Paczkowski, Mary W. | M.S., 1979 | N. D. State Univ. |
| Peregrino, Barbara | -- | N. M. State Univ. |
| Perez, Victoria (Philip.) | -- | VPI&SU |
| Prophete, E. H. (Haiti) | M.S.-in prog. | Texas A&M Univ. |
| Rajapakse, S. (S. Lanka) | -- | " |
| Severson, Mary C. | M.D., 1981 | Univ. Minnesota |
| Sparrow, Stephen D. | Ph.D., 1981 | " |
| Streeter, D. | -- | Oregon State U. |
| Talley, Linda J. | Ph.D., 1981 | Texas A&M Univ. |
| Taylor, Steven G. | M.S.-in prog. | Univ. Florida |
| Tremaine, Mary | M.S.-in prog. | Ohio State Univ. |
| Turco, R. F. | Ph.D.-in prog. | Wash. State Univ. |
| Vargas, Alvaro (Brazil) | -- | Univ. Minnesota |
| Wadisirisuk, P. (Thailand) | M.S.-in prog. | Texas A&M Univ. |
| Walker, David W. | Ph.D.-in prog. | " |
| Zary, Keith W. | M.S., 1978 | " |
| | Ph.D., 1980 | |

Attachment K

SUMMARY OF NUMBERS OF USDA-SEA/CSRS-AID RESEARCH PROJECTS*
DEALING WITH SPECIFIC LEGUMES

Food Legumes:

| | |
|--------------------------------------|-------------|
| <u>Phaseolus vulgaris</u> (bean) | 33 projects |
| <u>Vigna unguiculata</u> (cowpea) | 21 " " |
| <u>Arachis hypogaea</u> (peanut) | 12 " " |
| <u>Cajanus cajan</u> (pigeon pea) | 10 " " |
| <u>Vigna radiata</u> (mung bean) | 4 " " |
| <u>Lens culinaris</u> (lentil) | 4 " " |
| <u>Cicer arietinum</u> (chickpea) | 7 " " |
| <u>Vicia faba</u> (faba bean) | 3 " " |
| <u>Glycine max</u> (soybean) | 2 " " |
| <u>Phaseolus lunatus</u> (lima bean) | 1 " " |

Forage Legumes:

14 projects

[includes Medicago sativa and M. falcata (alfalfa), Lespedeza cuneata (sericea lespedeza), Stylosanthes guianensis and Desmodium sp.]

Tree Legumes:

| | |
|------------------------------|------------|
| <u>Leucaena leucocephala</u> | 3 projects |
| <u>Acacia pennatula</u> | 1 " " |
| <u>Gliricidia sepium</u> | 1 " " |

*Projects placing at least part of their effort with the legume listed.