BIOLOGICAL NITROGEN FIXATION

BNF BULLETIN

Summer/Fall 1992 Volume XI, Number 2

Outreach and Training for Technology Transfer

Mysteries of nature unraveling in research laboratories may hold answers to global problems of sustainable agriculture, hunger, and malnutrition; however, these need to be translated into practical techniques and applications. The links between farmers and researchers are made possible by agricultural training organizations and extension services. Recent BNF training activities in Uganda, Nepal, Austria, and Hawaii are examples of this effort.

UGANDA

Dr. Padma Somasegaran, NifTAL microbiologist, provided BNF expertise for the Applied BNF Technology Training Workshop held in Jinja, Uganda, June 29 - July 3, 1992. Other resource and teaching personnel included **Phinehas Tukamuhabwa** from Namolonge Research Station, **Charles Nkwine, Moses Mbalule,** and **James Muwanga** from with Makerere University.

The workshop was supported by the USAID BNF/Legume Management Outreach Project (BNF/LM-OPP). Other sponsors included Agricultural Cooperative Development International (ACDI), Uganda Cooperative Alliance (UCA), Uganda Cooperative Central Union (UCCU), and NifTAL.

The 29 participants represented a broad cross-section of the community — government agriculture and forestry agencies, non-governmental organizations, church-sponsored groups, and local farms. Formal presentations were integrated with hands-on, practical exercises to give them a good background in the application of BNF technology at the farm level. Demonstration field plots were examined for yield increases in inoculated beans and alfalfa. "The students were impressed by the differences between the inoculated and uninoculated plots," said Somasegaran,

Participants in the Uganda training course learn how to assess BNF by examining root nodules in the field.

"They could visualize the tremendous potential for the use of inoculants in Uganda." Television footage of the workshop was included in a program on BNF technology in Uganda as part of the *Farming World* series.

NEPAL

Malnutrition and poor soil fertility are among the most urgent problems in Nepal. Research has shown that inoculating grain legumes can increase productivity up to 60%. To address these problems and develop strategies to exploit the potential of BNF, a National Seminar in BNF in Nepal was held in Kathmandu in May 1992.

The seminar was attended by 40 people representing 18 government agencies and non-governmental organizations. Issues and needs expressed by participants were developed into clear policy statements in the areas of inoculant production and distribution, training and extension, and coordination of district and national policies. Priority recommendations included the establishment of regional inoculant production facilities and national training of BNF extension personnel.

Following the policy seminar, a five-day training workshop on BNF and legume management was conducted in Dhulikel. It was sponsored by BNF/LM-OPP, CARE-Nepal, and NifTAL. Resource persons included **Dr. Harold Keyser** of NifTAL, **Dr. K.D. Yami** from the Royal Nepal Academy of Science & Technology, **Dr. S.L. Maskey** of the Central Soil Science Division, **Netra Chhetri** from CARE-Nepal, and **Mike Feingold** with the Nepal Community Support Group.

The 26 extension specialists from government agencies and non-governmental groups learned about the role and importance of BNF and legumes in sustainable agriculture, inoculation methods, and research and demonstration techniques. According to Keyser, "The students learned about BNF in the context of whole cropping systems and soil fertility. This type of integrated training is important if BNF is to have an impact on Nepal's agriculture."

Continued on page 2

Dr. Yami discusses nodulation with trainees in Kathmandu, Nepal.

AUSTRIA

The Interregional Training Course on the Use of Isotopes and Radiation Techniques to Enhance Biological Nitrogen Fixation was held in Vienna, Austria, in June 1992, for participants from 21 countries. It featured lectures, practical exercises and demonstrations on inoculant production technology, and rhizobia identification techniques taught by Dr. Somasegaran. The course was sponsored by the International Atomic Energy Agency (IAEA) and FAO, and was organized by **Dr. Seth K.A. Danso** (Soil Fertility, Irrigation and Crop Production Section) and **Dr. Gudni Hardarson** (Soil Science Unit, Joint FAO/IAEA Programme).

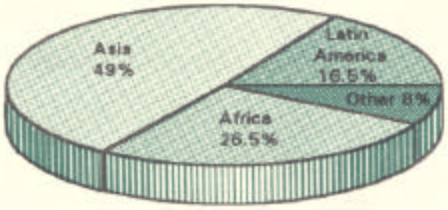
HAWAII

NifTAL shared its BNF expertise with its home state of Hawaii through a week-long workshop in July on applied BNF technologies for state extension agents. Eleven agents participated in the intensive, interactive course supported by the State Legislature through the LISA (Low Input Sustainable Agriculture) for Hawaii Project. During the course, they developed action plans for applying BNF technologies like green manuring with legumes in local cropping systems, planting leguminous ground covers for erosion control, and promoting the use of inoculants by small farmers.

Extension agents from Maui harvest a pot experiment as part of their training in BNF.

NifTAL's Training Programs

The benefits of BNF are not fully realized in many developing countries due to the lack of trained personnel. Since 1976, NifTAL has addressed this problem by expanding the pool of men and women who are able to establish and maintain BNF programs throughout the world.



NifTAL has trained over 500 scientists, technicians, and extension personnel representing 67 countries.

The training program uses three general approaches:

1. Postgraduate Training

Masters and doctoral candidates from the University of Hawaii or collaborating universities are awarded research assistantships. Many of NifTAL's graduates are now active in international agricultural development.

2. Intern Training and Visiting Scientist Program

Interns and visiting scientists participate in collaborative research projects with NifTAL staff. While conducting their projects, the visitors receive individually-designed instruction in topics as diverse as rhizobial microbiology, inoculant production, and legume agronomy. The participants are usually supported by their governments or by international funding agencies to gain specific skills to implement BNF projects.

3. Training Courses

The basic six-week course in legume/rhizobia technology was first offered in 1976, and continues to be popular. It covers all aspects of the topic through hands-on laboratory, field, and greenhouse exercises supported by lectures and demonstrations. Participants learn all the skills necessary to conduct their own BNF-related research.

NifTAL staff recognizes the need to extend validated BNF practices to farmers in the field. NifTAL specializes in a "training of trainers" program for extension personnel from government, business, and private voluntary organizations. Participants gain a comprehensive understanding of the applied aspects of BNF, and receive training materials to help them transfer this knowledge to other extension agents and farmers.

Most training activities are held in collaboration with other institutions, organizations, and businesses. Training courses can be customized with modular components to provide a specific focus as needed. The following units are now offered as specialized separate courses or in any combination:

* General Rhizobial Microbiology
* Strain Identification
* Genetic Technology of Rhizobia
* Inoculant Production
* Inoculant Quality Control
* Inoculant Enterprise Development
* Extension Training

NifTAL is now exploring opportunities to present BNF technology training as integral components of broader programs. For example, legume-based BNF can effectively complement efforts in sustainable agricultural systems, ecosystem restoration and conservation, erosion control, and soil nutrient management.

Tentative 1993-1994 Course Schedule

Additional courses will be organized as requested by collaborating institutions and funding agencies.

- ☐ Inoculant Production and Quality Control; Bangkok, Thailand; March 24 - April 30, 1993
- ☐ Legume Inoculant Production as a Business Enterprise; Hyderabad, India; August 9-20, 1993
- ☐ Techniques for the Study of Rhizobia Physiology and Ecology; Cairo, Egypt; September 6 - October 1, 1993
- ☐ Modern Methods for the Study of Rhizobia; Rabat, Morocco; January 10-18, 1994
- ☐ Methods in Legume BNF Technology; Aleppo, Syria; April 4-22, 1994
- ☐ Legume BNF Technology for Sustainable Agriculture; Chapingo, Mexico; August 1-26, 1994
- ☐ Legume BNF Technology for Extension Specialists; Nairobi, Kenya; November 7-18, 1994

For additional information, contact, Training Coordinator, NifTAL, 1000 Holomua Road, Paia, HI 96779-9744, USA, phone (808) 579-9568.

POINT OF VIEW

Commercializing BNF Technologies: Who Benefits?

By Tom Carr

NifTAL recently established an Office for Private Enterprise Development for the inoculant production industry. As the new Development Officer, it is my responsibility to develop a strategy for action. As I pursue my day-to-day tasks I sense skepticism mixed with curiosity from the academic research community, the private sector, and the financial supporters. The researchers may be wondering how this new private-sector support affects the direction of their work. Those from industry might be speculating on what NifTAL can do for them that they can't already do for themselves. The donors are possibly reflecting on the effectiveness of a well-known research institute such as NifTAL as an advisor in the commercial realm.

I can put some of these concerns and fears to rest by assuring my colleagues in the international bio-technology research community that their role is more important than ever as this program is dependent on their knowledge and participation. I anticipate a win-win situation as effective technology transfer and network programs are promoted and commercial aspects of inoculant production are developed.

The number of requests for our assistance from the private sector continues to increase. USAID and other international agencies who have supported our research for a number of years, both monetarily and with confidence in the technological potential, should see this trend as a logical extension of our research. With research focused on product enhancement, quality analysis techniques, production proficiency, and computer modeling for financial appraisals and on-farm benefit assessments, the link is obvious.

This venture into the private sector is more a means to a prudent end than a crusade for capitalism. NifTAL's rationale in promoting the privatization of the inoculant industry in developing countries lies in the premise that the ultimate beneficiary of commercially-produced and quality-tested inoculant is the *farmer end-user*. The means to ensure a reliable, viable, and affordable legume inoculant is through a sustained and profitable commercial operation. This rationale is certainly compatible with NifTAL's goal of increasing farm income and output while decreasing production input costs through introduction of BNF technology.

But why private sector? The main point is "sustainability," a term popularized by the development sector to describe systems which will endure long after government and donor programs have ended. NifTAL is convinced that private sector businesses are better equipped, staffed, managed, and financed for long-term, sustained operations. Government research centers which, despite highly skilled and accredited personnel, often operate under less than optimum conditions for sustainable operations.

These points can be debated by opponents and advocates without resolve, but we should not lose sight of the real goal — a better system for effective transfer of BNF technology to farmers. Although no statistics are available, the number of farmers using BNF technology appears to be decreasing, rather than increasing, in some regions of the world.

Doubters and opponents express concern about the possibility of private sector exploitation of the market place, commercial monopolies, and disregard for product viability. It must be stressed that NifTAL is advocating, with equal importance, the need to establish industry standards, mandatory external quality control testing, and product certification.

What about the farmers? They need a viable product with a clear economic return. Their level of confidence in BNF technology as a viable alternative to chemical fertilizer has a direct correlation to the corporate bottom line. This again strengthens the role the research sector performs in ensuring quality (not quantity) in the market place.

Are private-sector production and mandatory quality testing the only issues involved with BNF promotion? No, but while they are extremely important, we must not lose sight of the function of extension services in farmer education and the academic institutions in product development, research, and training. Another worthy objective is to improve networking and communication among research centers, extension services, and private-sector inoculant producers.

Let's join forces to work on this new focus. If you have alternative methods for effective and sustainable technology transfer, let me know — I'm listening. If you want assistance in developing commercial inoculant production operations, let me know — it's my job to help.

COMMERCIAL CORNER

MicroBio RhizoGen Corporation

MicroBio RhizoGen Corporation announces that they are expanding their research and production facilities. Their new address is 818 - 48th Street East, Saskatoon, Sask, S7K 3R3, Canada, phone (306) 373-3060, fax (306) 374-8610. MBR produces legume inoculants in Western Canada using indigenous peat. They have 16 fermentors on site, each with a working volume of 400 liters.

Computer Program for Financial Analysis

NifTAL has developed a computer program to evaluate the potential profitability of inoculant production enterprises. **FAIME** (**F**inancial **A**nalysis for **I**noculant **M**anufacturing **E**nterprise) is designed to assess the feasibility of starting a legume inoculant production facility or evaluate an existing enterprise. The program is based on production data collected from private and government inoculant producers in several countries.

According to Tom Carr, Private Enterprise Development Specialist, "FAIME is a great planning tool. The program allows the user to build a financial model of the business and 'play' with its components prior to taking any actual risk." Different strategies for allocating resources for start-up and operations may be analyzed, and different modes and scales of production and pricing may be modeled. One of the most powerful features of this interactive program is the **Sensitivity Analysis**, a "what-if" type of analysis. With this feature, the user can make changes in the values assigned to various financial and technical options. FAIME will then project the effect of these choices on the financial health of the business.

Contact Tom Carr at NifTAL for additional information.

From the Director's Desk

Through evolution, organisms adapt to the challenges of environmental change. Evolution of development institutions is similar. Program and technical successes eliminate particular constraints and lead to new challenges within a dynamic political, social, and economic environment. Key to NifTAL's success is the logical evolution we experience while pursuing our basic mission. That mission is to ensure that farmers and natural resource managers can derive full benefit from BNF through quality BNF products and technology.

NifTAL's early focus was on developing *Rhizobium* germplasm resources for tropical legumes and increasing technical capabilities of national institutions. There were significant constraints to delivering BNF technology to the field. NifTAL's original director, Sheldon Whitney, wisely added a legume management program. His successor, Jake Halliday, initiated extensive international network activities to field test germplasm and measure legume inoculation response. Joe Burton and Padma Somasegaran of NifTAL's research staff developed low cost fermentor systems, and inoculant production training was emphasized to improve inoculant products. Research efforts at NifTAL expanded under Ben Bohlool's leadership, especially in the areas of molecular biology and rhizobial ecology. Ecological research led to the development of models for predicting performance of rhizobia in the field. These models are now useful for planners and investors in BNF technology development.

The future is exciting. NifTAL has joined Texas A&M, Hawaii, Cornell, and North Carolina State Universities as a member of the Soil Management Collaborative Research Support Program (TropSoils CRSP). Through the CSRP we can further integrate BNF technologies into the larger issues of soil and natural resource management. This is appropriate as NifTAL matures into a comprehensive center of expertise. While prior successes have reduced some fundamental constraints to the adoption of BNF technologies, significant constraints still exist, and they help define our future strategy.

Our client-driven approach helps to focus research, training, communications, and enterprise development efforts. NifTAL has added new elements to meet our mission. For example, we have embarked on a significant effort to facilitate commercial production and marketing of quality legume inoculant products. This effort is supported by research and is directed at developing improved inoculant production, packaging, and quality control methodologies. Training programs are expanding to include business and marketing elements. We emphasize PVO/NGO and extension specialist training to enhance BNF technology adoption and market development. Genetic resource development targets forestry species as well as the survival and performance of rhizobia in inoculants. Another aspect of NifTAL's evolution includes collaboration with International Agricultural Research Centers. This linkage is expected to yield comprehensive management strategies to enhance BNF in cropping systems.

We review our history with pride and welcome the challenges ahead. The NifTAL staff looks forward to continued, as well as new, collaboration with dedicated colleagues throughout the world who share our development and research goals.

Paul Singleton
NifTAL Director

Dr. Paul Singleton was appointed Director of NifTAL in May 1992. He joined NifTAL in 1982 and served as Director of Research. He did his undergraduate work in Economics at the University of Colorado, and was awarded an MA in Agricultural Economics from the University of Florida. He received an MSc and PhD in Agronomy and Soil Science from the University of Hawaii. His doctoral research addressed the impact of salinity on the microbial and host processes of the soybean-Bradyrhizobium japonicum symbiosis.

Prospects for Nodulating Cereal

For years scientists have been intrigued with the prospect of symbiotic nitrogen fixation by economically important cereals and rhizobia. **Drs. M.K. Al-Mallay, M.R. Davey** and **E.C. Cocking** of Nottingham University, United Kingdom, have pioneered research in this exciting and controversial field.

During his visit to NifTAL in August 1992, Dr. Cocking reported on the progress his team has made inducing nodular structures on cereals. The researchers previously induced nodular structures on oilseed rape and rice by first treating the roots with cellulase and pectolyase enzymes, then inoculating with rhizobia. The enzymes apparently degraded root components which normally prevent rhizobial infection.

Cocking reported that altered root development in rice, rape, wheat, and maize in response to rhizobia has been observed, even without enzyme pretreatment. Researchers are inoculating the cereals with rhizobia that are able to induce stem nodulation on *Aeschynomene* sp. or nodulate the non-legume *Parasponia*. These special rhizobia apparently have an enhanced ability to penetrate the cereal roots and proliferate between the cortical cells. The rhizobia elicit a thickening of certain lateral roots, while root elongation stops.

Other scientists, primarily in China, are also pursuing various approaches to achieving nitrogen fixation by cereals. As with Cocking's team, results are still preliminary and subject to controversy. A breakthrough could revolutionize agriculture and have tremendous benefit for mankind.

Opportunities for U.S. Inoculant Producers

Interested in a joint venture? USAID is sponsoring a program of technology development through Indian - American R&D joint ventures. The project is called the "Program for the Advancement of Commercial Technology" and is centered in the PACT Division of the Industrial Credit and Investment Corporation of India Ltd., Bombay. Interested parties can write to NifTAL; or PACT, 163 Backbay Reclamation, Bombay 400 020.

News from the Cairo MIRCEN

The Biofertilizers Unit of the Cairo MIRCEN conducts applied research that supports national agricultural policies for Egypt. Researchers have targeted a variety of root-associated microorganisms for study. **Drs. N.I. Magdoub, M.E. El-Haddad, Y.Z Ishac,** and **M.I. Mostafa** report that young scientists are encouraged to enter new research fields in 1) stem nodulating symbiotic systems, 2) silicate bacteria as biofertilizers, and 3) interactions between *Rhizobium* spp. and cereal plants.

Researcher **Abo El-Soud** recently measured effects of nitrogen fertilization and soil type on the inoculation response of five legumes. His results showed that a low dose of nitrogen fertilizer increased nodulation. All legume hosts (faba bean, peanut, clover, soybean, and cowpea) responded positively to rhizobial inoculation in the three Egyptian soil types tested.

Cairo scientists also study VA mycrorrhiza, P dissolver *B. megatherium* var *phosphaticum*, *Azotobacter chroococcum*, *Frankia*, and *Pseudomonus fluorescens*. For further information, contact Cairo MIRCEN Director, Dr. M.N.I. Magdoub, Faculty of Agriculture, Ain Shams University, Cairo, Egypt, phone 20-2-2201172, fax 20-2-2584128, telex 20092 HELEO UN.

Future scientists from St. Joseph's third grade class examine rhizobia in NifTAL's microbiology lab.

ACIAR

Dr. E.T. Craswell reports that researchers at the Australian Centre for International Agricultural Research are planning a new project to use recently developed BNF measurement methodologies to assess and manage the nitrogen inputs from food legumes in cereal production systems in Pakistan and possibly Nepal.

Current research in Indonesia is focusing on BNF by soybeans in rotation with rice crops. Flooding of the rice plants and presence of rice roots can disrupt populations of nitrogen-fixing bacteria. An attempt is being made to optimize BNF by selecting strains of rhizobia to allow for different conditions prevailing in upland and lowland cropping systems. Another project is working on increasing the productivity of casuarina and eucalypt plantations by inoculation with selected symbiotic microorganisms.

A meeting of Australian BNF scientists was held in Canberra in October 1991, to review previous support of BNF research and to identify new directions and opportunities. The presentations are summarized in ACIAR Working Paper #37: "Review of ACIAR Research on Biological Nitrogen Fixation" edited by **Dr. I.R. Willett**. Reports cover

- micronutrient requirements for BNF and growth of legumes
- ecological studies of root nodule bacteria and use of legume inoculant
- BNF by soybean in rotations with rice
- ecology of rhizobia-nodulating tree and food legumes
- development and evaluation of methods to measure BNF
- production and utilization of shrub legumes
- multipurpose shrub legumes for infertile soils in the tropics

Recent ACIAR Research Notes providing BNF information include "Increasing the productivity of black wattle in China" (RN 2 10/90) and "Effects of iron deficiency on nitrogen fixation in peanut crops" (RN 8 6/91). For more information, write Research Programme, ACIAR, G.P.O. 1571, Canberra ACT 2601, Australia.

CIAT

The Role of the Legume in the Nitrogen Cycle of Productivity and Sustainable Pastures

Research at CIAT attempts to clarify the role of the legume in providing N for sustainable pasture systems. Studies simulate the fluxes of N in grazed pastures receiving no N fertilizer. Results published by **Dr. R.J. Thomas** indicate that the amount of legume-fixed N required to balance the cycle without draining soil organic N reserves was estimated to vary from 38% to 53% of above-ground herbage N (AGHN) or from 20% to 31% on dry matter (DM) for tropical pasture systems with a range of pasture utilization of 10% to 40%. At higher utilization levels of 50% to 70%, the N input increases from 57% to 67% of AGHN or 35% to 45% DM. These simulations also provide an insight into the relative importance of various recycling processes including internal cycling, litter decomposition, and excreta returns.

For more information contact R.J. Thomas, CIAT, Apartado Aereo 6713, Cali, Columbia or refer to Grass and Forage Science, 1992, Vol 47:133-142.

Dr. Natakorn Boonkerd, Director of the Biological Nitrogen Fixation Resource Center (BNFRC) in Bangkok, has been awarded the Agricultural Science Foundation Award for Outstanding Scientist for 1992 by His Majesty the King of Thailand.

NEWSWORTHY

Tropical Soil Biology and Fertility Programme (TSBF)

Dr. Peter Salema, currently with FAO/IAEA Joint Division in Vienna, is the newly-elected Chairman of the Board of Management of TSBF. He replaces **Dr. Pedro Sanchez**, of ICRAF, who just completed a three-year term. Dr. Sanchez notes that during these first three years, the organization has become recognized throughout the world as the leader in the biological side of tropical soil fertility and international soil research. For more information about TSBF, contact M.J. Swift, P.O. Box 30592, Nairobi, Kenya. TSBF is on line with CGNET e-mail network; their address is CGI416 for CGNET users, or TSAF@CGNET.COM for INTERNET users.

TSBF established a regional network in India during a workshop held in Kosani, Uttar Pradesh, April 6-10, 1992. This workshop was attended by 40 scientists from India and Sri Lanka and represented specializations in soils, ecology, biology, and agriculture. Of the seven major TSAF projects in the network, the BNF community should be most interested in the work being done with nitrogen-fixing trees and their relevance to the maintenance of soil fertility in North-Eastern Himalaya. Research topics include the albizzia-rhizobium associations. Principal investigator is **Dr. E. Sharma** at the G.B. Pant Institute of Himalaya Environment and Development, P.O. Box Tadong, Gangtok, Sikkim-737102.

In response to the needs identified by participants at a MIRCEN Training Workshop held in Nairobi in June 1991, TSBF established the Rhizobium Ecology Network in East and Southern Africa (RENEASA). Support has been received from UNESCO-ROSTA Biosciences Programme. Selected network coordinators are developing a standardized experimental package that will allow identification of the biodiversity of indigenous rhizobia in soils and enumeration of their respective population sizes without requiring full access to a complete microbiological laboratory.

According to **Michael A. Nyika**, participant in the 1991 Nairobi-MIRCEN Workshop, inoculant sales at Soil Production Research Laboratory Inoculant Plant in Zimbabwe have declined during the 1991-92 season due to the drought they have been experiencing for the last two years. SPRL is located at the Grasslands Research Station in Marondera.

MEETINGS

14th North American Symbiotic Nitrogen Fixation Conference. For 26 years on a two-year cycle, the North American Symbiotic Nitrogen Fixation Conference (formerly the *Rhizobium* Conference) has been a major vehicle for information exchange among various disciplines within the field. Although the conference is held in North America, participants (usually between 250-300) come from as many as 30 countries.

The co-organizers for the next conference are **Drs. Peter H. Graham, Michael J. Sadowsky, and Carroll P. Vance.** Subject matter ranges from the most basic to the very applied. This year's topics will include genetics, evolution, taxonomy and diversity, physiology, mineral nutrition, inoculant production and quality, non-leguminous symbiotic systems, environmental stress in symbioses, agronomic aspects, and international programs in biological N_2 fixation. The program includes invited and contributed lectures, round table discussions, poster sessions, and social events.

The 1993 Conference will be held July 25-30 at the University of Minnesota in St. Paul and immediately precedes the American Society of Plant Physiology Conference. For more information, contact Nancy Harvey, Program Coordinator, Educational Development System, 405 Coffey Hall, 1420 Eckles Ave., University of Minnesota, St. Paul, MN 55108-6068, USA, phone 612-625-8215, 800-367-5363 (USA only), fax 612-625-2207, e-mail INTERNET:nh@esp.mes.umn.edu

Other meeting and conferences of interest to the BNF community

International Seminar on Biofertilization in the Tropics will be held in Habana, Cuba on November 18-20, 1992. For information, contact Star Tour Promotion SA, Account #402-01-1447, Calle 21 esq O Vedado, Habana, Cuba, fax (57) 7-333152.

9th International Congress on Nitrogen Fixation meets in Cancun, Mexico, December 6-12, 1992. For further information, write Apartado Postal 565-A, Cuernavaca, Mexico, phone (73) 139877, fax (73) 173425.

8th North American Forest Soils Conference takes place in Gainesville, Florida, USA, May 9-13, 1993. For details, write to Dr. Phillip E. Pope, Purdue University, West Lafayette, IN 47907-1159, USA, phone (317) 494-3593.

1st Crop Science Conference for Eastern and Southern Africa will feature the theme *Sustaining Crop Production in Africa: Challenges to Science*. The conference will be held in Kampala, Uganda, June 14-18, 1993. Contact Dr. Adipala Ekwamu, Makere University, PO Box 7062, Kampala, Uganda, phone 256-041-531152, fax 256-041-531641.

10th International Symposium on Nitrogen Fixation with Non-Legumes will held be in Egypt, September 6-10, 1993. For more information, contact Dr. Nabil Hegazi, Faculty of Agriculture, 12613 Cairo University, Giza, Egypt, phone 02-724-368, fax 02-349-761.

10th Australian Nitrogen Fixation Conference is being planned for Brisbane, Australia in September 1993. For additional information, contact H.V.A. Bushby, 306 Carmody Road, St. Lucia, Qld 4067, Australia, phone (07) 377-0209, fax (07) 371-3946.

NFTA International Workshop on Rosewood (*Dalbergia spp.*) will be held in Hetauda, Nepal, in June 1993. Contact J. Roshetko, NFTA, 1010 Holomua Road, Paia, Hawaii, 96779, USA.

NEW PUBLICATIONS

Biological Nitrogen Fixation for Sustainable Agriculture

Edited by **J.K. Ladha, Thomas George, and Ben Bohlool**. This book is an outcome of the symposium jointly organized by the International Society of Soil Science and the International Rice Research Institute at the 13th International Congress of Soil Science, Kyoto, Japan, in 1990. Contents include a general perspective; trends in research and application; and investments, expectations, and actual contributions of BNF to agriculture. Sections cover BNF in non-leguminous field crops, mixed legume/grass pastures, mixed legume-cereal cropping systems, and trees in agro-ecosystems. Topics dealing specifically with rice focus on estimations and contribution of BNF to nitrogen balance in wetland rice fields, improving nitrogen-fixing systems and integrating them into sustainable rice farming, and managing native and legume-fixed nitrogen in lowland rice-based cropping systems.

Copies may be obtained from the Information Center, IRRI, P.O. Box 933, 1099 Manila, Philippines. Prices are $5 to developing countries and $19.25 to highly-developed countries. Postage is $8 airmail or $2 surfacemail.

Myths and Science of Soils in the Tropics

Edited by **R. Lal and P.A. Sanchez**. SSSA Special Publication Number 29. Proceedings of an international symposium sponsored by the American Society of Agronomy, the World Association of Soil and Water Conservation, and the Soil and Water Conservation Society, in Las Vegas, Nevada, in 1989.

This symposium explored several questions regarding the apparent imbalance between soil, food, and population growth in the tropics. Are soil resources of the tropics capable of sustaining high populations? What are the potentials and production constraints of these soils? What are the processes, factors, and causes of soil degradation? Can high production be achieved without degrading the soil and environment? The BNF community will be particularly interested in "Legume Response to Rhizobial Inoculation in the Tropics: Myths and Realities" by **P.W. Singleton, B.B. Bohlool, and P.L. Nakao**.

Copies may be obtained by writing SSSA, Book Order Dept., 677 South Segoe Road, Madison, WI 53711-1086 USA. The cost is $24, members first copy is $20.

Financial and Economic Analysis of Agroforestry Systems

Edited by **Gregory M. Sullivan, Susan M. Huke, and Jefferson M. Fox**. Proceedings of a workshop held in Honolulu, Hawaii, USA, in July 1991. The goal of the workshop was to reduce the imbalance between theory and application in agroforestry economics. Case study critiques explore methodologies and analysis. Included are findings of five working groups that address issues of data collection and analysis, on-station experimentation vs. on-farm research, economic analysis tools, marketing issues, and field evaluation techniques.

Copies may be obtained from NFTA, 1010 Holomua Road, Paia, HI 96778-9744, USA. The cost is $10.95 ($9.95 for NFTA associates) plus shipping and handling charges.

WHO'S WHO

Dr. Paul Godard

Dr. Godard received his PhD in Sciences, Crop Production at the Catholic University of Louvain in La Neuve, Belgium. He was at NifTAL in Spring 1992 preparing for a project entitled New Strategies for Farm-Based Economic Development: BNF with Marketing Extensions for Madagascar. This project is being conducted in collaboration with **Dr. Tom Lumpkin** at Washington State University in Pullman, Washington, USA. Start-up funding was provided by USAID and IMPACT, a Washington State Project. His work involved selecting legumes to be included in the project and learning about BNF laboratory and field techniques. He went on to Guatemala to continue his preparatory work.

Dr. Paul Singleton (center), appointed Director of NifTAL in May1992, with Dean Kefford (left) of the College of Tropical Agriculture and Human Resources and Samir El-Swaify (right), Chairman of the Department of Agronomy at the University of Hawaii

FOR YOUR INFORMATION

A database file on ground cover has been added to the Farmer's Bookshelf Information System as a Hypercard 2.0 stack that runs on an Apple Macintosh computer. It allows the user to specify up to four out of 33 ground cover criteria including soil moisture, shade, erosion control, flower color, plant, height, etc. For information contact Kent Kobayashi, UH-Manoa, Honolulu, HI 96822, USA.

An Agroforestry Information Service has been established as an information and resource network for the peoples of the Pacific. AIS will collect, organize, and distribute pertinent information on agroforestry technologies. Specific activities and products will include news releases; user/producer information database; field-oriented fact sheets; technical support; and collaboration with existing projects, networks, and institutions. This service is jointly supported by NFTA and the USDA Forest Services Tropical Forestry Program. For more information write to AIS-NFTA, 1010 Holomua Road, Paia, HI 96779-9744, USA.

N-FIXING TREE NOTES

The Nitrogen Fixing Tree Association Moves to Maui

NFTA is a nonprofit organization that encourages the improved understanding and use of nitrogen fixing-trees (NFTs) to help satisfy the wood-product demands in developing countries. Since its establishment in 1981, NFTA has evolved into an international network of 1400 individuals in over 112 countries who share an interest in NFTs.

The association promotes wise planting and management of NFTs to conserve soil and water, develop sustainable land-use systems, and safeguard against destruction of natural environments. Planting NFTs appropriate to the climatic and social conditions can improve rural landscapes and the lives of families who depend on that land.

This spring NFTA moved to the island of Maui from their former headquarters at the University of Hawaii's Waimanalo Research Station. NFTA is now housed under the same roof as NifTAL. Staff at both organizations hope to strengthen the linkage between the tree and rhizobial technologies and better serve the NFT and BNF communities.

NFTA is often confused with NifTAL. While they share many similar goals and techniques, NifTAL promotes BNF in general, and NFTA focuses on nitrogen fixing trees.

NFTA supports active outreach, research, and communications programs. **Jim Roshetko**, Program Director for Asia & Pacific, recently trained South East Asian community groups in the use of NFTs. In Fiji, he met with Pacific Island Resource Managers participating in the new Agroforestry Information Service (AIS), a service for peoples of the Pacific region. AIS will temporarily be headquartered at NFTA and will be directed by Program Associate **Karl Dalla Rosa**. **Dr. Joshua Daniel**, Area Representative (AR) for India, is supporting 15 community groups with NFTA development grants. **Rodrigo Arias**, AR for Guatemala, has established over 30 Cooperative Planting Program (CPP) species screening trials with community groups. **Mark Powell**, Program Director for the Americas, is working with **Donald Kass** at CATIE in Costa Rica to convene an international expert workshop on *Erythrina* in October. This meeting will result in a state-of-the-art silviculture manual for this species. A similar *Dalbergia* workshop in Nepal is planned to take place in June, 1993.

If you would like to learn more about NFTA, contact acting president **Jim Chamberlain**, NFTA, 1010 Holomua Road, Paia, HI 96779-9744, USA, phone (808) 579-9568, fax (808) 579-8516.

Program Director **Jim Roshetko** with training participants in Maloran, Lonbok, Indonesia, August 26-29. NFTA sponsored six Agroforestry/NFT trainings this summer. The Mataran training was co-sponsored by Save the Children, CARE, the Nusa Tenggara Upland Development Consortium, and NFTA.

Dr. Mike Benge of USAID (left), Research and Development, Environment and Natural Resources Section, visited NifTAL and NFTA in July. He discussed stategies for promoting NFTs with NFTA acting president **Jim Chamberlain** (right). Dr. Benge has maintained an interest in the use of *Leucaena* for agroforestry systems since he first saw this useful species in Southeast Asia more than 20 years ago. He has been instrumental in promoting its use thoughout the world.

SERVICES FROM NifTAL

RESEARCH

- Rhizobial germplasm
- Research quality inoculants
- Custom antisera
- Detailed field trial design for inoculation response studies
- Methods for rapid, low cost screening of rhizobia for soil stress tolerance

TRAINING

- Basic six-week courses
- Specialized extension and inoculant production courses
- Graduate degree support
- Short courses on genetic technologies, serology, and commercial inoculant production
- Training materials (manuals, slides sets)
- Visiting scientists program

OUTREACH

- Research and information networking
- National research program design assistance
- Technical backstopping to support developing country entrepreneurs
- Documents and information on BNF and tropical legumes
- Technical assistance on inoculant production systems
- Advisory services on inoculant manufacture, distribution, and quality control

BNF BULLETIN

Volume XI, Number 2
Summer/Fall 1992

BNF Bulletin is sponsored by the NifTAL Center which receives funding from the United States Agency for International Development.

For information on the NifTAL Center and to request services, contact NifTAL Center Director, NifTAL Center, 1000 Holomua Road, Paia, Hawaii 96779-9744, USA. Submission to the BNF BULLETIN may be sent: Attention: Communication Section.

The views and interpretations in this publication are those of the author(s) and/or the editor and should not be attributed to the Agency for International Development or to any individuals acting on its behalf.

Editor: Ann Coopersmith
Technical Editor: Patricia Nakao
Graphics and Layout: Debra Hughes

Printed on recycled paper with soybean oil ink.