BIOLOGICAL NITROGEN FIXATION

BULLETIN

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Re-Greening of Haiti: AID AOP's Attempt Through Tree Planting

Years of poor land use management, rising population, and increasing demand for agricultural and, in particular, wood products have resulted in serious environmental degradation in Haiti. In the forefront of efforts to reverse this trend is the USAID sponsored Agroforestry Outreach Project (AOP) whose initial phase ran from 1981 through 1986.

Recently refunded through 1990, AOP's goal is to reduce and ultimately reverse the ongoing degradation of Haiti's natural resources by motivating Haitian peasants to plant and maintain trees. In the course of accomplishing its primary goals, the project hopes to obtain reliable information on the technical, economic, and social variables of forestation in Haiti. AOP has adopted a unique strategy by supporting the idea of planting and harvesting trees as cash crops with near-term profitability. It thus appeals to the immediate self interest of cooperating small farmers. It also encourages tree planting by providing plant material, training, and support services to planters.

Harvesting one of the last few large Prosopis stands in the Northwest for charcoal.

Nitrogen-fixing leguminous trees, such as *Leucaena leucocephala, L. diversifolia, Samanea saman, Albizia lebbek, Gliricidia sepium, Calliandra calothyrsus,* and *Acacia auriculiformis* figure prominently in the AOP program. Because the tree seedlings experience severe environmental stresses upon outplanting—one of which is insufficient nitrogen in the poor soils of the outplanting sites—AOP Project nursery personnel routinely inoculate all susceptible seedlings with Rhizobium inoculant provided by NifTAL.

Reforesting hillsides dramatically reduces erosion and improves agricultural potential.

CARE, the Pan American Development Foundation, Operation Double Harvest, a coordination and technical support unit, and University of Maine and University of Florida research teams comprise the management and operational units of the Agroforestry Outreach Project. CARE and PADF work with small farmers in the Northwest and throughout the rest of the country, respectively. Operation Double Harvest works with large landowners helping them to improve the productivity of marginal lands through large scale tree plantings.

These organizations have established outreach programs designed to help the farmer manage all aspects of his own tree plantings, including making decisions on which species to plant, where and when to harvest, etc. Thus all benefits of trees planted accrue directly to the farmers. Although CARE operates its own seedling production and extension network, while PADF works primarily through local non-governmental organizations, both groups have established extensive regional nursery systems to service their outreach programs.

By any standards, AOP has been an unprecendented success. It developed, tested and proved that a tree planting extension methodology based on income-generation and self-interest can work. It has also stimulated over 200 local organizations to become involved in agroforestry activities in the course of which hundreds of persons have been trained in nursery installation, maintenance, extension, and in other areas related to tree planting and management.

Concrete accomplishments of the AOP include: the production and distribution of over 27 million fast-growing hardwood seedlings, the involvement of over 110,000 farmers in tree planting efforts demonstrating the economic potential of trees as a crop, the establishment of 39 regional nurseries with an annual production capacity approaching 15 million seedlings, the outplanting of 40% of project seedlings on hillsides where erosion control is desperately needed, and the establishment of over 60000 linear meters of Leucaena hedgerows set up in 500 small farmer-managed demonstration plots.

N-fixing Casuarina trees intercropped with vegetables yield wood products and enrich the soil via BNF.

If the project continues at its present pace several long term benefits are possible. Rural incomes and the incomes of those who transform wood products, e.g., charcoal makers, are likely to increase. Erosion may be reduced and environmental degradation reversed. If the physical and chemical properties of soils improve as a result of tree plantings, particularly on hillsides, overall agricultural production may rise. Lastly, if the present demand for AOP seedlings continues, wood from this one project will meet part of the domestic demand for wood products in Haiti.

- Joann P. Roskoski

Opportunities

Fellowships for African Researchers

The Project "African Agriculture: Crisis and Transformation," sponsored by the Joint Committee on African Studies of the American Council of Learned Societies and the Social Science Research Council, aims to establish a framework for interdisciplinary analysis of the agricultural crisis in Africa.

The project offers a program of fellowship activities which include analysis of biological processes which affect agricultural performance in Africa. The project has selected access, control, and use of resources as its focal theme during the fellowship program's first year, 1987-'88.

The typical fellowship award will provide up to $15,000 for support of activities during a period of 3-12 months. Fellowship support may be given for activities in three areas. The first area includes activities which will assist fellows in developing research project and proposals, including travel to libraries, literature searches, collection of bibliographic materials, visits to potential field sites, pilot studies, contacts with other researchers, and participation in workshops. The second area's activities, are those which will assist fellows in analyzing and writing up research results, including consultation with other researchers, participation in workshops to discuss preliminary findings, support for short periods of write-up, and participation in conferences to present and assess research results. Area three activities include those designed to provide specialized training needed to undertake particular kinds of research.

Individual African researchers and research teams comprised of African and non-African researchers in the following categories are eligible to apply: mid-career scholars based in universities or research institutes; individuals who have recently received graduate degrees; and professionals in government posts or other applied research settings. The second group of fellows will be selected in September 1987. For information about the program and application procedures, write to the Fellowship Program, Project on African Agriculture, Social Science Research Council, 605 Third Avenue, New York, NY 10158 USA.

International Training in Biotechnology

Developing country persons can be selected for training in biotechnology sponsored by Gesellschaft fur Biotechnologische Forschung mbH Braunschweig (GBF), Germany. GBF recognizes that the potential for applying biotechnology in developing countries was virtually limitless; but, that there is little activity in this area, partly because there is a profound shortage of individuals in these countries who possess the skills in advanced science and biotechnology needed to develop indigenous programs in industrial, medical, and agricultural biotechnology.

Participants are taught in courses lasting from one to two months which consist of providing both theoretical and "hands on" experience to the participants in order to enhance their ability to contribute directly toward the establishment of practical programs in biotechnology in their home countries and to provide local training for additional individuals.

Applicants may request an application form and additional information from any Embassy or Consulate of the Federal Republic of Germany or by writing directly to GBF at this address: Program Director, International Training Program in Biotechnology, Gesellschaft fur Biotechnologische Forschung, mbH (GBF), Mascheroder Weg 1, D-3300 Braunschweig, Federal Republic of Germany.

Being Compiled: Soybean and Mungbean Professional Directories

The AVRDC (Asian Vegetable Research and Development Center) is in the process of compiling data on professionals working on soybean and/or mungbean. The result of this compilation will be directories useful as a ready reference for communication and information exchange among researchers. Anyone interested in having his/her name appear in either directory can request a questionnare from Dr. S. Shanmugasundaram, The Asian Vegetable Research and Development Center, P. O. Box 42, Shanhua, 74199 Tainan, Taiwan, ROC.

Genetically Altered R. meliloti to be Field Tested

BioTechnical International's application to field test three strains of *Rhizobium meliloti* that have been genetically altered has been tentatively approved by the U. S. Environmental Protection Agency, reported Science in its 15 May issue. The organism, which the company has modified to improve its nitrogen fixing capability, would be tested on alfalfa at the company's research farm in Wisconsin if the final decision on the potential experiment is favorable.

A Novel "Leonard jar"

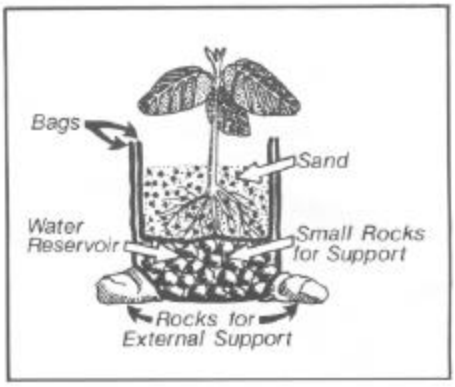
Dr. S.V. Hegde, Department of Agricultural Microbiology, University of Agricultural Sciences, Bangalore, India, has developed an intriguing variation of the standard Leonard jar.

The Leonard jar is used almost universally for testing *Rhizobium* strains under sterile conditions. It is a standard procedure, familiar to all *Rhizobium* workers, which was developed by Dr. Leonard, at the USDA Research Station at Beltsville, Maryland, in the early 1930s. It is generally constructed by cutting a bottle in half, and inserting the inverted top into the bottom. The top is filled with sterile growth media and the bottom serves as the reservoir for plant nutrient solution. A ready source of bottles is not always available, and anyone with experience cutting bottles knows that getting a good cut or break is an art not a science. Also, some glass tends to leave rough edges which can be a safety hazard.

Dr. Hegde's innovation consists of using plastic bags. The reservoir consists of a plastic bag filled with sterile rocks to give support. This simulates the bottom of the jar. The simulated top of the Leonard jar is a slightly smaller plastic bag filled with sterile sand to support the plant. To date, this has proven very satisfactory in service in Bangalore.

Dr. Hegde, was one of NifTAL's earliest trainees, having attended a training course in 1976. He has also visited NifTAL several times under the Indo-US Senior Scientific Panel for Joint Scientific cooperation. He is scheduled to return to NifTAL for several weeks in late 1987 as a visiting scientist.

- R. J. Davis



Ghanaian IAEA Fellow at NifTAL

Mr. Robert Abaidoo, a researcher and lecturer at the University of Science and Technology in Ghana, has been working as a visiting scientist at NifTAL since October 1986. His one year program has been sponsored by a fellowship from the International Atomic Energy Agency (IAEA) and funded by the National Academy of Sciences-National Research Council.

The main focus of Mr. Abaidoo's internship is the use of ^{15}N methods in quantifying nitrogen fixation in tropical legumes. In three greenhouse experiments with Dr. Chris van Kessel, he is evaluating the effect of phosphorus application on the atom % ^{15}N of reference crops not homologous to the fixing legume. And, in a field experiment with Drs. Paul Singleton and Ben Bohlool and NifTAL graduate student Thomas George, he is looking at the effect of nitrogen on nitrogen uptake, nodulation, and nitrogen fixation of soybean and bean.

In addition, Mr. Abaidoo is investigating with Dr. Padma Somasegaran the host-*Rhizobium* relationships and nitrogen fixation of bambarra groundnut *(Voandzeia subterranea)* an important pulse legume crop in Ghana. Mr. Abaidoo will present a poster on his work at the 11th North American Rhizobium Conference in Quebec this year.

A greenhouse study on lima bean cultivars in potted soil with Dr. Somasegaran and Mr. Heinz Hoben will conclude his program in November 1987. This experiment will investigate the inoculation response of the lima bean *(Phaseolus lunatus)* in an Ultisol and competition of inoculant rhizobia in the presence of native populations.

Upon his return to Ghana, Mr. Abaidoo will continue his work as a University researcher and lecturer. He will also become one of the 19 collaborators in the Worldwide Rhizobial Ecology Network (WREN), a NifTAL-administered project partially funded by the National Science Foundation.

Correction

The Porto Alegre, Brazil, MIRCEN address was inadvertently omitted from the list of MIRCENs in the last issue of the BNF BULLETIN. The address is:

Centro de Recursos Microbiologicos en Rhizobium (MIRCEN)
Departamento de Solos
Faculdade de Agronomia da UFRGS
Caixa Postal 776
90.000 - Porto Alegre - RS - Brasil

MOPP —• BAPP

Late in 1986, U Mya Maung, former Director of the Maize and Oilseed Production Project (MOPP), Agriculture Corporation, Rangoon, Burma, visited NifTAL Headquarters. He reported on results of the MOPP project which is to be replaced by a similar project known as the Burma Agricultural Production Project (BAPP).

The Agriculture Corporation, Ministry of Agriculture and Forests, the Government of the Socialist Republic of the Union of Burma and USAID/Burma-funded Maize and Oilseed Production Project is soon to be completed. Goals of the project were 1) to increase the production of maize and oilseeds (peanut, sesame, and sunflower), 2) to reduce importation of cooking oil in order to save foreign exchange, 3) to transfer agricultural technologies to the farmers, and 4) to produce certified seeds by establishing four seed farms.

Before the beginning of the MOPP project, importation of cooking oils was more than 10,000 tons per year. At that time in-country oilseed production was quite low. For example, the maize yield per acre was only 20 baskets. This has now been increased in the project areas up to 55 baskets per acre. This increase in maize production is due mainly to inputs of fertilizer. Sesame production increased from an average national yield of 3 baskets per acre to 12 baskets. This increase was primarily due to irrigation and fertilization. Production doubled from 3 to 6 baskets using irrigation alone and from 6 to 12 baskets with the addition of fertilizers.

A new crop introduced to farmers during the project was sunflower. Project personnel were challenged with the task of introducing this new crop; however, farmers soon learned they could realize larger profits by growing sunflower than other crops since sunflower has no native insect pests and diseases. Sunflower areas are being increased as the MOPP project makes quality seeds available to more farmers each year.

The oilseed legume promoted by the project, peanut (groundnut), formerly yielded 25 baskets per acre. Now as much as 40 baskets per acre can be expected during the rainy season and for the dry season, winter crop, the average yield is about 45 baskets per acre. In the project area, as many as 65 baskets per acre have been harvested. This increase was due to application of *Rhizobium* inoculants and phosphate fertilizer. No urea fertizers were used in the project area.

For the non-legume crops, provision of nitrogen fertilizer was quite cost effective since low cost urea was available from government-subsidized production facilities. The abundance of natural gas makes nitrogen fertilizer production plants affordable.

U Mya Maung, former director of MOPP.

To meet MOPP's outreach goal, farmers are taught the technologies of fertilizer applications, change of varieties, water management, pest management, row spacing, and *Rhizobium* inoculant applications. This outreach is done through extension workers trained and employed by the MOPP project. Training sessions which vary in length from a few days to more than a month are offered to both farmers and extension workers. These are practical courses which do not emphasize highly technical material.

Seed production has been begun by seed farms for four crops—these are divided into two foundation and two certified seed farms.

Key personnel on the project were U Khin Win (Managing Director); U Tin Hlaing (General Manager/Director of Extension and Education); U Sian Uk (Deputy Project Director); U Hla Than (Inoculant Producer); Dr. Charles A. Simkins (USAID/Agricultural Development Officer) and his staff; Dr. T.E. Bullard (Team Leader); Dr. Arlo Thompson (Sunflower Specialist); Mr. Ross Hagan (Water Management Specialist); and Dr. Frank Calhoun (Soil Scientist). U Sain Uk is implementing the transition from the MOPP to BAPP following the departure of U Mya Maung who has entered Ph.D. degree training at Ohio State University. And, Dr. Charles Simpkins has been replaced by Mr. Douglas R. Pickett.

"This project increases oilseeds so that we can produce more cooking oil and stop importation," says Maung. "The project has been successful since each year production has increased. For example, in fiscal year 1985-86, imports were reduced to 4,000 tons. It is possible that the project goal will be realized within the next two years. Since the project is going well, a second phase of the project would be appropriate."

Directions in Communication

Effective Posters

Official scientific communication at meetings and conferences is usually done using two methods—slide talks and posters. Although talks are often considered more prestigeous, posters are becoming the method of choice for many scientists. Posters promote in-depth one-on-one discussion between the author and interested persons, provide the ability to review material at leisure versus the limitations of a 10-minute talk, and allow for the use of a larger variety of materials and graphic techniques than slide talks.

As poster sessions continue to become more popular at scientific gatherings, potential poster presenters should familiarize themselves with some basics. Examples of questions a poster author should ask him/herself include: How large should the text and headings be and how large is the display space available for my poster? What information should I include? Are there specifics I should consider when creating graphs and tables? How can creative graphics enhance my poster?

Fortunately for persons presenting posters, meeting organizers usually include specific instructions on display space, allowable methods for attaching posters—i.e., tacks or tape, and other special instructions designed to standardize posters within a session. Some instructions also include allowable sizes for text and headings. A general rule for text lettering is that the poster should be readable from a distance of 1-2 meters. Thus, lettering should be at least 5 mm (¼ inch) high.

Generally speaking, the same information included in a paper or talk should be included in a poster, i.e., Summary, Introduction, Methods, Results, Discussion, and Conclusions. Posters should be clear and self-explanatory, but extensive details should be reserved for personal discussion. Text should be in short, concise, legible statements which can be easily read by the audience. A clear, simple message is the most effective for persons reading or studying your poster while you are away. If you have details that seem essential to be included, a presenter can prepare a short, detailed handout or leave a supply of business cards with the poster.

When showing results, the same rules for simplicity apply to tables and charts. The most useful and communicative table or chart does not have the largest possible amount of material, but points out especially interesting or relevant findings. Using color in charts is very effective; this also has the benefit of attracting attention.

Creative graphics are one of the most effective ways of making a poster more eye-catching and communicative. Arrows, photographs, headings, and a careful arrangement of materials will help the poster viewer follow the flow of information and better understand the work done on the particular experiment. Type styles are diverse and nearly any style can be used on a poster. When considering size of type, the 1-2 meter rule virtually eliminates the use of standard typewritten text. Machine made typeset text is the most professional looking, however, some large type typewriters, enlarged typewritten text, and computer plotters make attractive textural material.

The goal of either an attractive, informative poster or a talk is to communicate a scientist's research findings. As authors become more "poster-literate," they will become better able to meet the challenges of this innovative communication technique.

NEW PUBLICATIONS

NifTAL Final Report/Report 1986

The NifTAL Project, University of Hawaii, has recently entered into a new Cooperative Agreement (CA) with USAID. The final report for the first contract period (1975-1986) has been published in combination with annual report 1986. This publication is available to interested persons. Request a copy from the NifTAL Information Section.

Symbiotic N-Fixation Technology

A new release from Marcel Dekker, Inc., this book offers step-by-step guidance in the latest techniques. Edited by Gerald Elkan, chapters are written by highly reputed specialists in the field of N-fixation. For Information on obtaining copies, write Marcel Dekker, Inc., 270 Madison Avenue, New York, NY 10016 USA.

Mycorrhiza Book Available

Fifty copies are available of University of Hawaii Research Bulletin 194, **Research for Tropical Agriculture by Barbara Mosse.** This 1981 publication is a review, state-of-the-art report on Vesicular-Arbuscular Mycorrhiza from 1930-1978. Request a copy from the NifTAL Information Section.

"Pages of Contents"

CIAT's Communication and Information Support Unit is offering this monthly publication which gathers into six specialized packages the titles of recent articles published in major agricultural journals. Subject areas covered by the service are General Agriculture; Plant Physiology; Plant Protection; Soils and Plant Nutrition; Pastures, Animal Production and Nutrition, and Agricultural Economics and Rural Development. For the subscription price of this useful service, write to: CIAT, Communications and Information Support Unit, Library Services/Subscriptions, A.A. 6713, Cali, Colombia.

Enough Food

This book is published by Rodale Institute. It outlines the conceptual framework for the potential role regenerative—low input, sustainable—farming systems have in improving agricultural productivity and self-reliance in the Third World. Originally printed in English, printings in French and Spanish will be available by 1 September 1987. A short booklet will also be available at that time which focuses on six case studies of successful projects using regerative agriculture. The cost of Enough Food is $5 which includes surface postage; for airmail, add $1. The cost of the follow-up booklet has yet to be determined. Order from Rodale International, Attn: Robert Wagner, 222 Main Street, Emmaus, PA 18049.

short takes

J.A. Scaglia, FAO, reports that he is working in Rwanda on the extension of inoculant use for legumes and Azolla in paddyfields. He was formerly in Bhutan where he set up a small-scale inoculant production lab. This lab is now under the direction of Mr. **Tsewang Dorji.**

The government of Karnataka State, India, has recently given the Microbiology Department, University of Agricultural Sciences, Bangalore, half a million rupees to develop an inoculant produc-

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Meeting Notes

Rhizobium Discovery Centennial

The 7th International Congress on N_2-fixation will be held in Cologne from 13-20 March 1988. Besides covering all aspects of the legume-*Rhizobium* symbiosis, the meeting will begin with a review of the discovery, and history of *Rhizobium* during the past 100 years. Persons interested in attending the meeting should contact Professor H. Bothe, University of Koln, Botanisches Institut, Lehrstuhl, Gyrhofstrabe 15, D-5000 Koln 41 (Lindenthal), West Germany.

10th Trifolium Conference

This conference held biannually is the only national meeting where clovers are the focal point. Dates for the meeting are 24-25 March 1988. For information on this meeting contact Gerald W. Evers, Secretary-Treasurer, Tenth *Trifolium* Conference, Texas Agricultural Experiment Station, Texas A&M University, P.O. Box 728, Angleton, TX 77515 USA.

Australian Society for N-Fixation Met

One hundred and fourty registrants attended the 8th Australian Nitrogen Fixation Conference in Adelaide, Australia, at Waite Agricultural Research Institute from 1-5 December 1986. The meeting was organized to mark the retirement of Professor D.J.D. Nicholas, well known scientist in the area of Nitrogen metabolism. It was also the first meeting of the Australian Society for Nitrogen Fixation, which provided a broader forum than earlier Australian Legume Nodulation conferences.

Copies of the Proceedings may be obtained from the Australian Institute of Agricultural Science, 191 Royal Parade, Parkville, Victoria 3052, Australia ($15 Aust. post-free).

The conference organizing committee pictured here from left to right are Bill Wallace (organizer), Sally Smith (Secretary), Paul Reddell, Jim Silsbury, Peter Gibson, and Wojtek Michalski. Absent are Angus Alston (Treasurer) and Trish Rosbrook.

4th International Symposium on Molecular Genetics of Plant-Microbe Interactions

The first announcement is out for this Symposium which will be held in Acapulco, Mexico, from 15-20 May 1988. Previous meetings in this series have been held every two years since 1982 in Bielefeld, Ithaca, and Montreal. The main goals of the meeting will be to give a quick overview of the field, to review unpublished results, and to stimulate discussion on the new avenues that research can take in the future.

Most of the research work will be presented as posters. Oral sessions will include presentations by some invited speakers as well as by some poster authors that will be selected in situ by the corresponding chairpersons. Scientific organizer of the meeting is Rafael Palacios.

For more information on this meeting write to: Viajes Kuoni de Mexico, S.A. de C.V., Hamburgo No. 66 - 2nd Floor, Col. Juarez, 06600 Mexico, D.F. Mexico.

Soybean Technology Workshop

Dr. Ali Hilali, a BNF scientist at the Hassan II Institute in Rabat, Morocco, participated in the Soybean Technology Workshop at the Regional Farm Fair held in Agadir, Morocco, during November, 1986. He displayed a poster outlining the importance of inoculation with *Rhizobium*.

Dr. Hilali who received his Ph.D. in soil microbiology from the University of Minnesota spent several weeks in 1986 at NifTAL as a visiting scientist. While in residence, he conducted joint experiments with NifTAL scientists and learned advanced techniques for small and largescale inoculant production.

Mungbean Symposium Scheduled

The Second International Symposium on Mungbean will be held 16-21 November 1987 in Bangkok, Thailand. Sponsors are AVRDC, Thailand Department of Agriculture, Kasetsart University, and AVRDC-Thailand Regional Outreach Program. Objectives of the symposium are to review the latest advances in mungbean research, to understand the economics of mungbean production and to determine the production constraints and to identify potential areas of future research and cooperation. For information, contact S. Shanmugasundaram, Chairman, Program Committee, The Second International Mungbean Symposium, AVRDC, P.O. Box 42, Shanhua, Tainan 74199, Taiwan, ROC.

Rhizobium Topic of Italian Conference

Pictured here are many key international BNF workers who were among the participants at the Workshop held at Amalfi, Italy, from 7-11 April 1987. Molecular biology of the *Rhizobium*-legume symbiosis was the subject of the meeting. Specific discussion topics were genetics and physiology of free-living *Rhizobium*, host/*Rhizobium* recognition, structure and function of *nod A B C D*, and other *nod* and *nif* genes, bacteriods, nodulins, and host genetics. The meeting was organized by J. Beringer, R. Defez, M. Iaccarino, and M. Nuti.

4th International Symposium on N-Fixation with Non-Legumes

A variety of scientific and development organizations will sponsor this meeting to be held in Rio de Janiero, Brazil, 23-28 August, 1987. The symposium will focus on recent advances in the interaction of N-fixing microorganisms with non-leguminous plants. For this meeting, the organizing committee plans to give special emphasis to comparisons of the infection processes and mechanisms of various systems. The legume/*Rhizobium* symbiosis will be included as an example. For more information contact Dr. I. Fendrik, Institut fur Biophysik, Universitat Hannover, Herrenhauserstr. 2, D-3000 Hannover 21, Fed Rep. of Germany.

COMMERCIAL CORNER

Seed Treatments

Industry, universities, extension services and advisors must continue to inform farmers that *Rhizobium* inoculants provide the symbiotic nitrogen fixing bacteria which act as a biological nitrogen fertilizer with legumes. When we speak to growers about "seed treatments," we think about *Rhizobium* inoculants, but frequently they are referring to fungicides or other chemicals. A grower market research study concerning *Rhizobium* inoculants summarized the knowledge level of the average U.S. farmer as low. Misconceptions are common. Inoculants are often confused with fungicides or fertilizers. The word "Rhizobia" was even confused with "Rhizoctonia."

"Seed treatment" is too broad a phrase referring to many products used for very different reasons. "Inoculant" (a product which introduces a microorganism) is likewise too general. This term may suffice currently, but several microbial processes are being researched and developed, and may soon become agronomic practices. The following is a list of current or potential products which may be applied to seeds. Which one are you referring to when you speak of "seed treatment?"

A word to the wise: Don't ask a grower if he treated his seed. Be specific.

R. Stewart Smith
Nitragin Company

Fertilizers

Biotic:	Abiotic:	Combination:
Nitrogen fixing - Symbiotic Legume Inoculant - Rhizobium Inoculant Non-Legume - Associative - Mycorrhizal	Molybdenum	Pelleting – *Rhizobium* inoculant + nutrients + Lime, etc.

Pesticides (Abiotic or Biotic)

- Fungicides - Bactericides	- Nemstocides - Herbicides	- Insecticides

(Shorts) Continued from page 4
tion facility. This is being directed by the Head of the Microbiology Department, Dr. **P.V. Rai.** The building to house this facility is now nearing completion on the grounds of the University adjacent to the Microbiology Department.

(Course) Continued from page 8
port of the practical exercises was given in 24 lectures. This course focused on commercial inoculant production. As in the previous course, the fermentors used were stainless steel units built in Thailand from a design developed at NifTAL's Maui Headquarters.

(Fermenter) Continued from page 8
down the temperature of the culture medium upon sterilization. Heat for sterilizing the culture medium is by bottom heating with a 980 BTU gas burner.

A modified version of the fermenter (built locally in Thailand) is based on the specifications of the prototype unit and was built at NifTAL's Biological Nitrogen Fixation Resource Center (BNFRC) at the Rhizobium Building, Department of Agriculture, Bangkhen, Thailand. This modified version is equipped with a coil which is not only used for cooling but which can also be used for steam heating during the sterilization cycle.

The simplicity of operation and acceptability of the fermenter design for small and medium scale inoculant production was clearly demonstrated during three training courses on *Rhizobium* inoculant production technology held at NifTAL Headquarters in Hawaii and BNFRC, Thailand.

More information on inoculant production fermenter units can be obtained by writing to Drs. Padma Somasegaran (NifTAL Project, 1000 Holomua Avenue, Paia, Maui, HI 96779 USA) and Nantakorn Boonkerd (BNFRC, Department of Microbiology, Rhizobium Building, Bangkhen, Bangkok 9, Thailand).

Legumes in the Kitchen

The ultimate application of BNF technology is using legumes as a food source for humans. Legumes provide a high source of protein for improving dietary nutrition while serving as a key ingredient in many low cost, delicious meals.

How better to provide an opportunity for discovering these culinary delights than offering you recipes with legumes as the main ingredient. All measurement conversions are approximate.

Middle Eastern
Garbanzo Bean Dip

1 can (450 ml or 15-16 ounces) garbanzo beans or 115 grams (¼ pound) dry garbanzo beans, cooked
45 ml (3 tablespoons) fresh lemon juice
30 grams (2 tablespoons) finely chopped onion
2 large cloves garlic, finely chopped
⅛ litre (½ cup) olive oil
30 grams (2 tablespoons) dairy sour cream
Salt and freshly ground pepper (to taste)
30 ml (2 tablespoons) olive oil
30-40 grams (2 to 3 tablespoons) snipped fresh parsley

Puree beans, lemon juice, onion, and garlic in blender, food processer, or through food press. If using an electric blender or food processer, while machine is running, slowly pour in olive oil; process 10 seconds. If by hand, mix olive oil well into bean mixture. Stir in sour cream and season to taste with salt and pepper. Refrigerate covered 4 hours or overnight. To serve, pour bean mixture into a shallow serving bowl; make a well in center. Pour 30 ml (2 tablespoons) olive oil into well. Sprinkle with parsley. Serve at room temperature with warm pita bread or raw vegetables.

The BNF BULLETIN welcomes contributions of recipes from our readers. Bon apetit...

Dr. Jacob Schiffman In Memoriam

BNF Workers will be saddened to hear of the passing of Dr. Schiffman. In 1952, he founded the Division of Legume Inoculation at the Volcani Institute, Bet Dagan, Israel, which he headed until his retirement in 1973. He was the first scientist in Israel to isolate and select symbiotically effective rhizobial strains and, using local materials, develop the technology of inoculant production now used in Israel.

One of his significant contributions was the development of inoculant and an inoculation technique used by Israeli peanut farmers. This technology is the liquid injection inoculation method of spraying inoculant suspended in water into the planting furrows at the time of sowing. A special bacterial suspension applicator was developed for this purpose.

Dr. Schiffmann was regarded by his colleagues as having an encyclopedic knowledge and a rare courtesy. He is survived by his wife and three children. (Submitted by B. Kishnevsky, R. Lobel, and D. Gurfel)

N-FIXING TREE NOTES

Deeply rooted multi-use trees such as acacia, prosopis, carob, and others are promising as nitrogen sources for the soil because they are drought resistant and produce food, fodder, and fuel, as well as fixing nitrogen. Eventually, an integrated approach to dry land soil fertility maintenance may be developed using nitrogen fixing trees.

Research in the southern California, USA, desert near the Salton Sea by members of the Dry Lands Research Institute, San Diego State University, UCLA, and Washington University, St. Louis, has provided the first look at the deep soil interactions between rhizobia and prosopis.

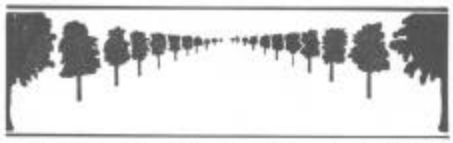
Although prosopis is capable of fixing nitrogen, excavation of the surface root system and soil chemical analysis showed that little or no nitrogen is fixed by the surface roots. Few nitrogen-fixing root nodules have been recovered from the surface soil; and none occur where the surface soil is high in salts and inorganic nitrogen. Yet, measurements of the nitrogen isotope abundance in plant tissue have shown that the rhizobial symbiosis provides about 70% of the annual uptake of nitrogen by prosopis.

Population density of prosopis-nodulating rhizobia was considerably higher at depths of 5-6 meters than in surface soils. The numbers of rhizobia at this depth were comparable to the numbers in surface agricultural soils supporting herbaceous legume crops.

This study showed that symbiotic organisms can function far below the surface and that more attention should be paid to the ecology of the deep soil. This is particularly important for the dry lands. This work was reported in Drylander, v1n1, 1987.

Sarah Workman, a U.S. Peace Corps volunteer, served for over 3 years in Ouagadedougou, and Po, Burkina Faso. She was placed there as a forestry volunteer in connection with the Village Forestry Program—a continuing program of the Ministry of Environment. An international team of funding agencies promoted the Program as a fight against desertification and promotion of the implementation and use of improved models of wood stoves and of more efficient wood use.

Ms. Workman's job was to manage a tree nursery of several different species, both exotic and local species—many of which were leguminous. Of the exotics, prosopis was well received, and four acacia species became more widely planted. Some fruit trees such as mangoes and cashews were well planted and taken care of by farmers because they had the potential of becoming cash crops. According to Workman, regional nursery problems such as transport of seedlings during the rainy season led to development of village nurseries which were in the charge of extension agents. Positive results of efforts she observed were visible regrowth in arid areas and improved soil techniques such as the use of trees to erosion.



Alley cropping using hedgerows of nitrogen fixing trees (NFT) can be beneficial in cycling nitrogen to companion food crops concludes K. Mulongoy in an article in IITA Research Briefs, December 1986. He reported on work being done to assess the benefit of organic matter decomposition and nutrient transfers from NFT green manures to crops.

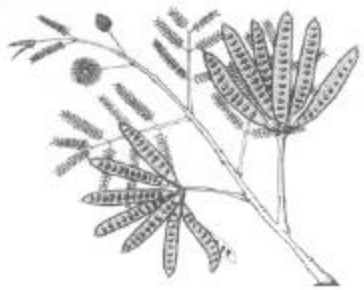
He noted that pruning is one of the most important management factors affecting BNF NFT symbiosis of NFTs. Pruning limits the supply of photosynthates to the nodules, particularly when hedgerows are pruned too low. N-fixation is affected and nodule decay and sloughing-off are induced, resulting in nutrient (essentially N) release from decomposing roots and nodules and shedding of rhizobia into the rhizosphere.

If NFTs are to be of maximum benefit in these systems, release and mineralization of their nutrients must be related to the requirements of the companion food crop. It is possible that experimental data will predict the best time for pruning and the minimum amount of pruning and the minimum number of hedgerow trees from which the necessary prunings for economic yield increases can be obtained.

More information is needed to determine the amount of N from prunings transferred to the food crop. Research must be done with reference to the following:

- the rate of decompositon and release of nutrients from prunings of alley shrubs
- the rate of mineralization of these nutrients and their profile in the soil
- the amount of nutrients tied up in the soil biomass and organic matter
- the proportion of N prone to leaching and volatilization in a given ecosystem
- the actual transfer of nutrients to the food crop and the benefits expressed in terms of N economy

Improved management methods can make better use of the decomposition process which is closely linked to mineralization and immobilization of nutrients. Further data on N cycling will undoubtedly contribute to improved management of alley cropping systems through optimizing N utilization and developing a system that will be economically superior to the prevailing methods of shifting cultivation.



The benefits of NFTs are spreading to all manner of development worker with even missionary groups describing Leucaena as a "miracle tree."

Dr. Foster B. Cady, Research and Development Director of the F/FRED Project is presently circulating a form designed to obtain information on multipurpose tree species (MPTS) specialists. This very specific form will gather information for F/FRED's Specialist Database which is expected to ensure efficient information exchange within the F/FRED research network. Persons wishing to be added to the Specialist Database should complete the questionnaire. Address inquiries to Dr. Foster B. Cady, Research and Development Director F/FRED Project University of Hawaii, P.O. Box 186, Paia, HI 96779 USA.

Rhizobium Technology Course

Ten *Rhizobium* scientists from nine ASEAN countries received training in Rhizobium technology in a course held during March 1987. The Course which emphasized inoculant production was conducted at the Rhizobium Building of the Thai Department of Agriculture (DOA) in Bangkhen, Bangkok, Thailand.

Organized and hosted by DOA and NifTAL's Biological Nitrogen Fixation Resource Center (BNFRC), the course was sponsored by the Food and Agricultural Organization (FAO) of the United Nations. Mrs. Yenchai Vasuvat and Dr. Nantakorn Boonkerd were the local organizers of the course. Instructors were BNFRC Director Dr. Boonkerd, and NifTAL Microbiologist Dr. Padma Somasegaran and Training Coordinator Heinz J. Hoben.

Scientists selected for participation in this course were: Mrs. Shahida Nasreen and Dr. Abdul Hamid (Pakistan); Mr. Jusuf Soepriaman (Indonesia); Mrs. P.R. Samaradeewa (Sri Lanka); Mrs. Fe S. Torres (Philippines); Mr. Li Xin (People's Republic of China); Dr. Kang Jun Cho (Korea); Mrs. Delowara Kanam (Bangladesh); Dr. V.N.P. Gupta (Nepal), and Mr. Nguyen Hai Nam (Viet Nam).

This four-week intensive course was similar in content to an inoculant production course taught a year earlier in Thailand. The course provided "hands on" experience in 18 exercises in general *Rhizobium* microbiology, strain identification techniques, field and greenhouse experiements, and inoculant production. Theoretical knowledge in sup-

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Dissemination Update

Included with this issue of the BNF BULLETIN is a mailing list update. It includes a copy of your mailing label. Please make any necessary changes, complete the card, and mail to the NifTAL Communication Section. PERSONS NOT RETURNING THE UPDATE CARD WILL BE DELETED FROM THE BNF BULLETIN MAILING LIST. Please give us your correct mailing address and therefore allow us to serve you better.

NifTAL Fermenter Design is Adaptable

NifTAL-designed inoculant fermenter units are in operation at diverse locations. Currently, these fermenter units are being used for production in Thailand, Indonesia, Bangladesh, and Nigeria. NifTAL's original prototype fermenter was built because of the need to produce quality inoculants.

Inoculants for legumes are produced by blending broth cultures of *Rhizobium* with sterile carrier material such as peat. A major consideration in inoculant production is the mass culturing of *Rhizobium* which is an important factor determining the scale of inoculant production. Mass culturing requires suitable fermenters; these vessels must be simple enough to allow for easy sterilization, access to inoculation and sampling, aeration, and cleaning. To insure durability, strength, and resistance to chemical action, stainless steel is the optimal fabrication material.

Using commerically available portable stainless steel pressure vessels, scientists at NifTAL successfully designed and evaluated an autoclave-cum-fermenter for mass culture production of *Rhizobium*. This vessel serves a dual purpose: initially, it serves as an autoclave when the culture medium is sterilized in it; upon cooling and inoculation, it does double duty as a fermenter.

The capacity of NifTAL's fermenter is 140 litres. A built-in cooling coil for circulation of cool water is used to bring

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NifTAL PROVIDED SERVICES

OUTREACH

- Rhizobial germplasm
- Research quality inoculants
- Custom antisera
- Distribution of symbiotic plasmids and cloned genes
- Detailed field trial design for inoculation response studies
- Long-term rhizobia repository
- Methods for rapid, low cost screening of rhizobia for soil stress tolerance

TRAINING

- Basic 6-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, etc.)
- Visiting scientist's program

RESEARCH

- 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

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For information on the NifTAL Project and to request services, contact NifTAL Project Director, NifTAL Project, 1000 Holomua Rd., Paia, Hawaii 96779-6744. Submission to the BNF BULLETIN may be sent: Attention: Communication Section.

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