International Soybean Program
INTSOY NEWSLETTER
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
113 MUMFORD HALL, URBANA, ILLINOIS 61801 USA
CABLE: INTSOY, TELEPHONE (217) 333-6422

NO. 1, AUGUST, 1974

WHAT IS INTSOY?

The International Soybean Program (INTSOY) is a cooperative program between the College of Agriculture of the University of Illinois at Urbana-Champaign and the University of Puerto Rico, College of Agricultural Sciences, Mayaguez.

The newsletter you are reading is the first issue. We plan to publish future issues every two or three months. If you know other people interested in INTSOY programs and activities, they can receive future issues by writing to the address above and asking to be included on our mailing list.

INTSOY was formally established in 1973, but its organizational roots are planted in the long-standing international interests and activities of several institutions. The University of Illinois has long been interested in soybean research and development both domestically and internationally. Through cooperation with other agencies — particularly the U.S. Department of Agriculture — the U. of I. has developed extensive programs. At the same time, the University of Puerto Rico has had a long-term interest in food legumes and more recently has focused attention on soybeans. The institution also contributes a high level of expertise in tropical and subtropical agriculture.

INTSOY is concerned with all phases of soybeans from planting the seed to consumption. These phases include production, harvesting, marketing, processing, and utilization. INTSOY's major interest is in the exploitation of the unique potential of soybeans as a source of protein for direct human consumption. Research centers primarily on the problems of tropical and subtropical environments but is also concerned with nutrition and processing as ways to expand use of soybean protein foods in human diets.

The INTSOY program is developing cooperative work with, and through support from, the U.S. Agency for International Development, international research centers, foundations, universities, and other agencies. Outreach activities, including assistance with research, extension, and long-range agricultural development, have been initiated with several countries. Currently, USAID and the Rockefeller Foundation provide most of the financial support, but a broadened base of support is needed to attain the full potential that rests in INTSOY.

SOYBEAN CONFERENCE IN ADDIS ABABA

In collaboration with the Institute for Agricultural Research, Imperial Ethiopian Government, INTSOY is sponsoring a regional conference on soybeans for interested persons in Africa, the Middle East, and South Asia to be held October 14-19, 1974. The program will focus on four major areas — research, production, protection, and utilization. The Wabe Shabelle Hotel in Addis Ababa will be conference headquarters. For more information, contact Dr. D. K. Whigham, conference chairman, University of Illinois, 216 Davenport Hall, Urbana, Illinois 61801 USA.

WORLD SOYBEAN RESEARCH CONFERENCE

Mark your 1975 calendar and make plans to attend the World Soybean Research Conference to be held August 4-8, 1975, at the University of Illinois at Urbana-Champaign. The conference will be sponsored by the U. of I., the U.S. Department of Agriculture, and the U.S. Agency for International Development. To receive additional information, write Dr. R. W. Howell, conference chairman, University of Illinois, W-201 Turner Hall, Urbana, Illinois 61801 USA.

SOYBEAN TRAINING PROGRAMS IN 1975

In early 1975 INTSOY will sponor two training courses in cooperation with the U.S. Department of Agriculture and the U.S. Agency for International Development. A six-week course on "Soybean Processing for Food Uses" beginning in mid-March will include study of: soybean use for food; making foods from whole soybeans, soybean meal, and oil; and principles and methods of controlling food quality. The program will include orientation in Washington, D.C., two weeks of technical and applied training at the University of Illinois, and a two-week study tour of midwestern and southeastern states.

A 20-week course on "Technical and Economic Aspects of Soybean Production" will start in early

May, 1975, and is scheduled to coincide with the Illinois soybean growing season. Following a two-week orientation in Washington, D.C., there will be 15 weeks of training at the U. of I. The program will include studies of agronomic and plant protection practices, mechanization of production and harvesting, and the economics of production and marketing. There will be a two-week study tour of soybean growing areas of the midwestern and southern states, and an evaluation in Washington, D.C., will conclude the program. For more information about these courses please write to INTSOY.

NEW PUBLICATIONS

An INTSOY publication series has been established, and four publications are available. A fifth, published by the University of Illinois College of Agriculture Cooperative Extension Service, is also available.

— "Selected Literature of Soybean Entomology," George L. Godfrey, Ed., INTSOY Series No. 1, April 1974. Twenty-three papers drawn from the areas of arthropod surveys and pest management, the bionomics of major species, the effects of arthropod feeding and plant resistance, and insecticide residues.

— "Proceedings of the Workshop on Soybeans for Tropical and Subtropical Conditions," INTSOY Series No. 2, May 1974. Papers presented at a workshop held February 4-6, 1974, at the University of Puerto Rico, Mayaguez Campus.

— "A Case Study of Expeller Production of Soybean Flour in India," S. W. Williams and K. L. Rathod, INTSOY Series No. 3, April 1974. A report of a technical and economic case study illustrating ingenuity in modifying facilities to produce low-fat soybean flour with limited capital investment.

— "Soybean Processing in India: A Location Study on an Industry to Come," Mattias von Oppen, INTSOY Series No. 4, July 1974. A report of a study to determine optimal size and location of soybean processing plants in India using a mathematical model simulating a future soybean processing and marketing industry.

— "Cooking With Soybeans," Donna C. Mueller, Barbara P. Klein, and Frances O. Van Duyne, University of Illinois College of Agriculture Cooperative Extension Service, Circular 1092, May 1974.

INTSOY publication distribution policy: Single copies will be mailed on request free of charge. Prices on quantity orders — based on costs of printing and mailing — will be quoted on request. Write to INTSOY, 113 Mumford Hall, Urbana, Illinois 61801.

THE INTSOY PROFESSIONAL STAFF

William N. Thompson, Director

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Robert E. Dunker, Assistant Agronomist, Field Trials

Leslie K. Ferrier, Food Science, Chemistry

Victorio Garcia,* Soybean Pathology

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Errol D. Rodda, Agricultural Engineering

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NO. 2, NOVEMBER, 1974

CONFERENCE HELD IN ADDIS ABABA

A conference on soybean production, protection, and utilization for scientists in Africa, the Middle East, and South Asia was held in Addis Ababa, Ethiopia, in October. Sponsored by Ethiopia's Institute of Agricultural Research and INTSOY, it was the second in a series of regional workshops designed to bring scientists together to consider the potential of soybeans as a major world food crop.

The theme of the conference was the exchange of information and research findings. Reports from each country represented at the conference gave participants an opportunity to compare their plans, activities, and problems. A display of soybean literature and foods, many of which were prepared by the Ethiopian Nutrition Institute, attracted much interest. A field trip to the University Agricultural Experiment Station at Debra Zeit provided an opportunity to observe an INTSOY variety trial as well as research on several other crops.

Papers were prepared by: S. Abu Shakra, chairman of crop production and protection, American University of Beirut, Lebanon; Werner Plarre, visiting scientist, July 1973 to July 1974, International Institute of Tropical Agriculture (IITA), Nigeria; R. K. Jana, senior lecturer of agronomy, University of Dar es Salaam, Tanzania; R. B. Dadson, lecturer of crop science, University of Ghana, Ghana; R. C. Finlay, visiting research fellow in crop science and production, University of Dar es Salaam, Tanzania; J. C. Delouche, in charge of Seed Technology Laboratory, Mississippi State University, USA; M. von Oppen, economist, International Center for Crops Research in the Semi-Arid Tropics (ICRISAT), India; V. M. Bhan, agronomist, G. P. Pant University of Agriculture and Technology, India; D. W. Johnson, president, Food Ingredients, Inc., Park Ridge, Illinois, USA; S. Irineu da Costa, head, Lipids and Proteins Section, Instituto de Technologia de Alimentos (ITAL), Brazil; O. G. Bentley, dean, College of Agriculture, University of Illinois at Urbana-Champaign; and INTSOY staff members C. N. Hittle, D. K. Whigham, J. B. Sinclair, R. M. Goodman, and L. K. Ferrier.

The conference was funded by a grant from the U.S. Agency for International Development. Single copies of the proceedings can be obtained by writing to INTSOY.

SOYBEAN VARIETY EVALUATION TRIALS

In an attempt to determine the adaptability and production potential of different soybean varieties in various environments, 90 soybean variety evaluation trials were distributed to 55 countries during the last 9 months of 1973. Twenty varieties, representing a wide range of genetic material, were tested at each location, with local varieties substituted at some locations.

The maximum yield reported, based upon data from 16 countries, was 4,826 kilograms per hectare (72 bushels per acre), and the average high yield from 35 locations was 2,388 kilograms per hectare (36 bushels per acre). Hardee, Williams, and Davis were the most consistently high-yielding varieties tested. Variety × environmental interaction was significant at every location. Environmental conditions in the tropics caused more varieties to flower early, to set pods close to the ground, and to develop short plants. These early results indicate that maturity group designations used in the United States are not valid in most tropical and subtropical environments.

Results from all the 1973 variety evaluation trials will be summarized and made available to interested scientists. For more information write D. K. Whigham, 216 Davenport Hall, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801 USA.

SOYBEAN GENETICS NEWSLETTER

The second volume of the Soybean Genetics Newsletter is now being prepared by Dr. Reid G. Palmer, U.S. Department of Agriculture, Iowa State University. The focus of this newsletter is the genetics and breeding of the soybean and its immediate relatives, broadly interpreted to include areas relating to genetics in fields such as taxonomy, pathology, entomology, physiology, and biochemistry.

INTSOY is a program of the University of Illinois at Urbana-Champaign and the University of Puerto Rico — Mayagüez Campus cooperating with international and national organizations to expand the use of soybeans for human food.

Information in the newsletter is presented informally; these reports should not be considered the equivalent of papers published in formal scientific journals. The content of newsletter articles may be preliminary or speculative in nature. The goal is to stimulate thought and the exchange of ideas among soybean scientists. Data presented in the newsletter are not to be used in publications without the consent of the author.

It is hoped that the newsletter can reach interested persons in as many disciplines as possible. If you would like to receive the Soybean Genetics Newsletter, write to Reid G. Palmer, USDA, Soybean Genetics Newsletter, Department of Agronomy, Iowa State University, Ames, Iowa 50010 USA.

DATES SET FOR TRAINING COURSES

Dates for training courses to be offered by INTSOY in 1975 have been set: Soybean Processing for Food Uses, March 5 to April 14; and Technical and Economic Aspects of Soybean Production, April 30 to September 6. These courses will be conducted at the University of Illinois at Urbana-Champaign by INTSOY in cooperation with the U.S. Agency for International Development and the U.S. Department of Agriculture. Although the courses were originally designed for USAID-sponsored participants, trainees may be sponsored by other national and international organizations. For further information, contact the USAID mission in your country or INTSOY.

PEOPLE AND PLACES

Three new names have been added to the list of INTSOY professional staff reported in the first issue of the INTSOY Newsletter.

Guillermo Riveros has been appointed associate professor at the University of Puerto Rico, Mayaguez Campus. Dr. Riveros, who formerly was plant pathologist and weed control scientist at the Instituto Colombiano Agropecuario, will teach undergraduate and graduate courses in weed control and will also conduct weed control research with soybeans. Dr. Riveros has many years of experience in weed control in Colombia and is the author of several publications on that topic. He earned his M.S. and his Ph.D. degrees in plant physiology from the University of California, Davis.

E. Hamer Paschal II joined the INTSOY staff at the University of Illinois at Urbana-Champaign as assistant professor in the Department of Agronomy. His headquarters are at the University of Puerto Rico, Mayaguez Campus. His work is in breeding soybeans for the tropics and subtropics. He received his B.S. and M.S. degrees from Texas A & M University and his Ph.D. degree from Purdue University in 1973. Dr. Paschal has been conducting research on bean breeding in Brazil during the past year under a cooperative program with Purdue University, the Brazil government, and the U.S. Agency for International Development.

Michael E. Irwin was appointed assistant professor in the Office of Agricultural Entomology, College of Agriculture (UIUC) and the Section of Economic Entomology, Illinois Natural History Survey. He received his B.S. degree from the University of California, Davis, and his Ph.D. degree from the University of California, Riverside, in 1971. Dr. Irwin has worked in several Latin American countries and most recently has been with the Natal Museum, Pietermaritzburg, South Africa. His INTSOY research will be in the development of insect management programs for tropical and subtropical environments.

While abroad for the Ethiopian workshop, INTSOY staff members took the opportunity to visit variety evaluation trials, international agricultural research centers, and collaborators in soybean research in an effort to stimulate interaction among soybean scientists.

Among the visitors from the University at Urbana-Champaign were: Dean Orville Bentley, conference keynote speaker, who visited the International Institute of Tropical Agriculture (IITA), Nigeria; Bob Goodman, who traveled to Nigeria and Ghana; Jim Sinclair, who went to Egypt and Iran; Keith Whigham, who visited Ghana and the Ivory Coast; Bill Thompson, who visited Saudi Arabia; and Carl Hittle, who traveled to Saudi Arabia, India, Sri Lanka, and Pakistan.

Others who have traveled recently include Kuell Hinson, USDA, University of Florida, and A. H. Boyd, Mississippi State University, who went to Guyana under a USAID task order; Tom McCowen, Office of Overseas Projects (UIUC), who visited India and Sri Lanka; George Godfrey and John Bouseman, Section of Economic Entomology, Illinois Natural History Survey, who traveled to Mexico; Al Harms, Department of Agricultural Economics (UIUC), and Lyle Grace, Champaign County farmer, who visited the Ivory Coast to advise on soybean management, production, and harvesting problems.

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NO. 3, FEBRUARY, 1975

INTSOY ENTOMOLOGICAL PEST MANAGEMENT PROGRAM

In this issue of the Newsletter we are beginning a series of articles to better acquaint you with INTSOY. Each article in the series will focus on one aspect of the overall program. We hope that you will find these articles informative and suggest that you keep a Newsletter file for future reference. The entomological pest management program, an integral part of the INTSOY production and protection program, will be our first topic.

The INTSOY pest management program is relatively new. The principal objective of the program is to devise and disseminate pest control strategies that encourage economically high yields. These strategies emphasize biological, genetic, and cultural tactics while minimizing the use of chemical agents.

Devising strategies requires research; disseminating these strategies requires outreach activities. Both are essential for a successful program.

Delineating the major soybean pest species around the world is a preliminary phase in the research program planned by INTSOY entomologists. The bionomics of soybean pests and their associated biological control agents — predators, parasites, and pathogens — is being studied in view of economic injury levels as they relate to yield loss. The effects of cultural manipulation are also being studied.

Part of the research conducted by INTSOY entomologists is done in cooperation with other units in the INTSOY program. For instance, research in the development of insect-resistant soybean varieties is part of an overall breeding program designed to produce high-yielding, nutritionally improved, disease- and insect-resistant varieties for the tropics and subtropics.

Another area of cooperative investigation is virus-vector research. An experiment is currently under way in Puerto Rico that should determine the speed with which soybean mosaic virus spreads through soybean fields by aphids, the only known vector. Laboratory tests are also being conducted to help find simple and economical methods for isolating potential vectors of soybean viruses under field conditions.

To aid research on soybean insects, two computerized systems have been developed — the Soybean Insect Research Information Center (SIRIC) and the International Reference Collection of Soybean Arthropods (IRCSA). SIRIC now contains over 12,000 citations of scientific notes, papers, and reports that deal with all aspects of soybean-associated arthropods. IRCSA contains over 1,500 different species of soybean-associated arthropods from 25 different countries. Data on the insects in this collection are computerized by crop variety and phenology, locality, species, and similar data.

The dissemination of information about soybean insects, such as that contained in SIRIC and IRCSA, is a major part of the entomology outreach program. Exhaustive bibliographies of important soybean arthropods, based upon references compiled by SIRIC, have been published and will be updated periodically. Bibliographies are now available on the following pests: *Epilachna varivestis* (the Mexican bean beetle), *Nazara viridula* (the Southern green stink bug), *Cerotoma trifurcata* and *C. ruficornis* (the bean leaf beetles), and *Anticarsia gemmetalis* (the velvet bean caterpillar).

Individual profile sheets on pests and beneficial soybean arthropods are in the planning stage. These will include abbreviated notes on the insect's description, biology, and distribution; the damage that it causes (if a pest); diseases that it carries (if a vector); its host-plant range (if a pest) or its host-insect range (if a parasite or predator); recommended control measures; and other data.

INTSOY entomologists are currently conducting research in Illinois and in Puerto Rico. They hope to expand their research and outreach programs and invite your cooperation in developing comprehensive soybean pest management strategies.

The INTSOY pest management team is led by Michael E. Irwin. George L. Godfrey is in charge of IRCSA. Barbara Ford coordinates the activities of SIRIC. While not officially a member of INTSOY, Marcos Kogan, leader of the Illinois Natural History Survey soybean entomology team, lends a great deal of support to the INTSOY pest management program.

RESEARCH ON SOYBEAN SEED STORAGE

A new project on soybean seed storage is under way in Puerto Rico. Eliodoro Ravalo of the Department of Agricultural Engineering, University of Puerto Rico, Mayaguez Campus, and Errol Rodda of the Department of Agricultural Engineering, University of Illinois at Urbana-Champaign, are working under a grant supporting INTSOY programs from the Rockefeller Foundation.

Objectives of the project include determining requirements for maintaining seed viability under tropical conditions, evaluating seed storage containers for the farm or village, and determining the moisture content of soybean seed needed to minimize damage in handling and planting.

GREEN LIGHT FOR INTSOY SHORT COURSES

Registration for two INTSOY short courses mentioned in the last issue of the Newsletter is now sufficient to allow us to proceed.

"Soybean Processing for Food Uses" will be held March 5 through April 14, 1975. "Technical and Economic Aspects of Soybean Production" will be held April 30 through September 6, 1975. Both courses will be taught at the University of Illinois at Urbana-Champaign.

PLANS FOR A THIRD REGIONAL INTSOY CONFERENCE

INTSOY announces a third regional soybean conference, designed primarily for soybean scientists in Asia and Oceania. The conference will be held in early 1976. The location and dates for the meeting are under consideration.

The conference will last four days and will cover soybean production, protection, and utilization. Discussions of general interest will be supplemented by symposia on specific topics, such as soybean rust, seed quality, and photoperiod sensitivity.

INTSOY PUBLICATIONS

Two new titles, one published by INTSOY and the other published by the Illinois Natural History Survey, are now available.

— "Potential Production of Soybeans in North Central India." S. W. Williams, W. E. Hendrix, and M. K. von Oppen. INTSOY Series No. 5, 1974. 21 pages.

— "IV. A Bibliography of the Velvet Bean Caterpillar, *Anticarsia gemmatalis* (Hubner) (Lepidoptera: Noctuidae)." **The Literature of Arthropods Associated with Soybeans.** B. J. Ford, J. R. Strayer, J. Reid, and G. L. Godfrey. Illinois Natural History Survey Biological Notes No. 92, 1975. 15 pages.

Single copies of each can be obtained by writing to INTSOY.

WORLD SOYBEAN RESEARCH CONFERENCE

The program for the World Soybean Research Conference, to be held August 3-8, 1975, has gone to press and will be mailed soon to those on the WSRC mailing list. The conference will be held at the University of Illinois at Urbana-Champaign.

PEOPLE AND PLACES

A tip of the INTSOY hat and best wishes in their study programs to the following people:

William Grisley, a master's candidate in Agricultural Economics who is studying the economics of soybean production in Puerto Rico.

U. Pe Maung Thein, a Food and Agriculture Organization fellow from Burma who joined the Department of Agronomy at the University of Illinois at Urbana-Champaign in January. Mr. Thein will follow a one-year practical program in technical and economic principles and practices of soybean production.

David Sammons, formerly with the Audubon Society, who has begun doctoral study in the UIUC Department of Agronomy. His appointment is under a Rockefeller Foundation grant, and his work will be closely linked to the INTSOY soybean-breeding program.

Among the recent visitors to INTSOY offices at UIUC were the following: S. Shanmuga Sundaram of the Asian Vegetable Research and Development Center, Taiwan; Lloyd Frederick, Professor of Soil Microbiology at Iowa State University; Herbert Albrecht, Director of the International Institute of Tropical Agriculture, Nigeria; Paul R. Crowley of the U.S. Department of Agriculture; and J. K. McDermott and Thomas Arndt of the Agency for International Development.

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NO. 4, MAY, 1975

INTSOY PATHOLOGY PROGRAM

This article continues our series describing aspects of the INTSOY program. The objectives of INTSOY'S research in pathology are to identify the limiting soybean diseases in the tropics and subtropics, to generate basic information about soybean pathogens that can be used to predict their spread and importance, to devise methods to control or reduce the impact of soybean diseases, and to assist in breeding tropically adapted soybean cultivars with resistance to important pathogens.

Soybeans are historically a crop of the temperate regions, and so our knowledge of soybean diseases is based primarily on experience in temperate latitudes. Therefore, our first important objective is to identify diseases that occur in soybeans in the tropics and subtropics.

INTSOY pathologists from the University of Illinois at Urbana-Champaign and the University of Puerto Rico, Mayagüez Campus, are closely observing soybeans and other more common tropical legumes at various substations of the Estación Experimental Agricola in Puerto Rico. Diseased tissues are collected, and the pathogens are isolated and identified. INTSOY personnel also cooperate with other pathologists around the world to keep abreast of developments in soybean pathology elsewhere.

Preliminary studies on soybean diseases in the tropics and subtropics indicated several areas that will require more detailed research. Further studies are now underway to determine the nature of the whitefly-transmitted pathogen that causes a severe yellow mosaic disease of soybeans in Puerto Rico and Asia. Other studies are designed to measure the field spread of soybean viruses that are also seedborne. Attention will be given also to viruses not usually found in soybeans in temperate areas and to multiple virus infections that may be important in the tropics.

Another important area of research is in the role of seedborne microorganisms in seed deterioration and death. Studies by INTSOY pathologists center on the nature of the microorganisms involved, the mechanisms of seed or embryo death, and control measures to exclude the microorganisms during seed production or to mitigate their effects. Results of studies at Illinois indicate that a bacterium found in the soybean seed coat may contribute to poor stand establishment of soybeans in the tropics.

A third area of study is now under consideration. Cooperative studies on soybean rust disease are being planned with other U.S. and Asian pathologists to develop effective, inexpensive ways to control the disease until rust-resistant germplasm can be incorporated into agronomically desirable cultivars.

Methods of controlling plant diseases vary, depending on the properties of the pathogen and host and the circumstances under which the crop is grown. Control of virus diseases usually depends upon the plants' resistance to infection or upon control of vectors that spread the virus. In practice, only a few viruses are controlled by controlling the vectors, and so our emphasis is on breeding of virus-resistant cultivars.

Diseases caused by seedborne fungi and bacteria, on the other hand, can in some cases be controlled by application of fungicidal or antibiotic chemicals. Results of studies at Illinois show that fungicides are useful to control some seedborne fungi. A similar approach is being investigated for control of the seedborne bacterium mentioned earlier. When appropriate, changes in cultural practices may also be effective in reducing or avoiding disease occurrence.

INTSOY pathologists, like other INTSOY personnel, attach great importance to their role in promoting exchange of scientific information and in communicating results of their research to other scientists in soybean development programs abroad. They maintain frequent contact with soybean scientists in national, university, and international soybean programs. Dr. Prateung Sangawongse, Senior Plant Pathologist in the Oil Crop Branch, Ministry of Agriculture, Thailand, has recently completed a six-month study at the University of Illinois on the interaction of the soybean cyst nematode and the charcoal rot pathogen. His work was sponsored by INTSOY and the Department of Plant Pathology.

INTSOY pathologists are completing work on an international soybean disease compendium and bibliographies of the soybean disease literature and the soybean virus literature. These publications will become available from INTSOY during 1975.

The INTSOY pathologists are Victorio García (Puerto Rico), Robert M. Goodman (Illinois), Pedro L. Meléndez (Puerto Rico), and James B. Sinclair (Illinois). Drs. García and Meléndez study fungal diseases of soybeans; Dr. Goodman, virus diseases and virus epidemiology; and Dr. Sinclair, seedborne fungi and bacteria.

SOY ENRICHES TRADITIONAL NIGERIAN FOOD

The Nigerian Federal Institute of Industrial Research has granted permission to INTSOY to reproduce a recent issue of its *Technical Information Bulletin for Industry* (Vol. 2, No. 3). The bulletin describes the development of soy-enriched ogi, the traditional maize food used by millions of children and adults in Nigeria. The bulletin discusses the production process, necessary equipment, economic considerations, and the potential market among consumers. A flow chart illustrates the process.

Reproductions of the article can be obtained by writing to INTSOY.

PROCEEDINGS OF ADDIS ABABA CONFERENCE RELEASED

"Soybean Production, Protection, and Utilization — Proceedings of a Conference for Scientists of Africa, the Middle East, and South Asia" has been published as INTSOY Series No. 6. The editor is D. K. Whigham.

The conference was envisioned as a catalyst to a continuing process of technical exchange among those interested in soybean research, education, and development. Ninety-seven participants from 27 countries attended the conference.

Copies of the proceedings have been mailed to conference participants. Single copies will be sent to researchers interested in soybean problems in the tropics and subtropics. Prices on quantity orders will be quoted on request.

SOYBEAN PROCESSING COURSE COMPLETED

Certificates were awarded on April 10 to 13 persons from 10 countries who completed the first INTSOY-sponsored short course, "Soybean Processing for Food Uses."

Participants arrived in Washington, D.C., on March 5 for a brief orientation before continuing to the University of Illinois at Urbana-Champaign. After 2½ weeks of lectures, demonstrations, and laboratory assignments, the group took a 10-day, five-state field trip to visit processing plants, equipment manufacturers, and research institutions.

Participating in the course were Luis E. Zapata M. (Colombia), Ricardo R. del Rosario (Philippines), Jae Heung Lee (Korea), Decio A. Travaglini (Brazil), Afredo Lam-Sánchez (Brazil), Camilo Antonio Rozo (Colombia), John F. Okorio (Kenya), Mrs. Chandra Breckenridge (Sri Lanka), Mrs. Susanna Mahamah (Ghana), Ana V. Román (Costa Rica), Pracha Boonyasirikool (Thailand), Jonathan K. Quartey (Ghana), and Ariel Espinoza Correa (Nicaragua).

Leaders of the course were Professors A. I. Nelson and Leslie K. Ferrier of the Department of Food Science.

UPDATE ON WORLD SOYBEAN RESEARCH CONFERENCE

Registration requests are arriving for the World Soybean Research Conference to be held August 3-8, 1975. Over 800 inquiries have been made — about one-third from outside the United States.

The conference program is set, speakers have been contacted and confirmed, and preliminary programs have been mailed. If you have not received information on the WSRC and are interested in attending the sessions or obtaining a copy of the proceedings, write to R. W. Howell, conference chairman, W-201 Turner Hall, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801 USA.

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NO. 5, AUGUST, 1975

SIMPLE PROCESSING OF WHOLE SOYBEANS

This article continues a series highlighting different INTSOY activities. In this issue, processing and using whole soybeans for food will be featured.

The soybean is an excellent source of major nutrients. About 40 percent of the dry matter in soybeans is protein. The amino acid pattern of soy protein approaches the optimum as recommended by the Food and Agriculture Organization. Soybeans are also about 20 percent fat. This oil is quite desirable because it contains a large proportion of unsaturated fatty acids. In addition, soybeans are a good source of the required vitamins and minerals. Thus, the soybean has great potential for people who rely mostly on vegetable sources for protein.

Nearly all soybeans in the United States are processed in oil-extraction plants. The oil generally is used for cooking, mayonnaise, salad dressing, and margarine. The extracted flakes are used mainly for animal feed; however, use of the extracted flakes for food is increasing rapidly. Some products that are processed for human food from the extracted flakes include soy protein concentrate, isolated soy protein, textured vegetable protein, and soybean analogs.

The direct use of whole soybeans in preparing foods for home use and for commercial processing is another means of utilizing the soybean for human food. The Department of Food Science of the University of Illinois at Urbana-Champaign has developed procedures for processing whole soybeans into a number of products that have real potential.

The processing procedure is straightforward and uncomplicated. The basic process starts with field-dried soybeans, which are carefully cleaned to remove foreign material and damaged or moldy beans. After cleaning, the beans are hydrated by soaking in tap water for at least five hours. The hydrated beans are then precooked (blanched) in boiling water for 20 to 30 minutes. For products that require tender blanched beans, 0.5 percent sodium bicarbonate is added to the water.

After this process is completed, the beans are bland in taste and chewy to tender in texture. The bland taste of soybeans treated in this way is directly related to inactivation of enzymes, principally the lipoxygenase enzyme system, present in the raw soybean before the tissue is disrupted.

Properly hydrated and blanched soybeans have great potential for processing into a wide variety of food products. At the University of Illinois, soy food products have been grouped into five major categories:

1. Dry powders consisting of 100-percent whole soybeans or a combination of soy and rice, soy and corn, soy and bananas, or other mixture.
2. Canned food products, including vegetarian soybeans, three bean salad, and soybeans mixed with chicken, pork, or lamb.
3. Dairy product analogs such as plain and flavored soy beverages, ice cream, yogurt, and blends of soy beverage and cottage cheese whey.
4. Spreads, including diet margarine, potato chip dip, and a peanut butter analog.
5. Snack foods, including roasted soybean cotyledons and extruded puffed rice and corn fortified with full-fat soy flours.

Other scientists have reported the use of whole soybeans for the preparation of high-protein foods. Soybean-maize mixtures are used in tortillas in Latin America. Ogi, the traditional fermented corn dish of Nigeria, has been fortified with whole soybeans. In India, a soybean dal has been developed. Dal is a staple in many Indian diets.

These examples illustrate the wide variety of tasty and nutritious foods that can be manufactured from a single material — the cooked, whole soybean. We believe they demonstrate great potential for this versatile food ingredient, and we believe that these and other soybean products can be adapted to fit the taste and texture preferences of people throughout the world.

SOYBEAN PRODUCTION SHORT COURSE UNDER WAY

Since May 14, 16 persons from 15 countries have been participating in a 17-week course entitled, "Technical and Economic Aspects of Soybean Production." The course is designed to provide an opportunity to learn the technical and economic principles and practices of soybean production and

to study the research, educational, and regulatory functions supportive of a soybean industry. The course participants are assisted in relating this information to both their personal objectives and those of their country in the use of soybeans to alleviate protein-calorie deficiency problems.

Participating in the course are Simin Amindari (Iran), Conrado R. Bartolome, Jr. (Philippines), Miguel A. Berasain (Uruguay), Claudette Bernard (Jamaica), Moon-Sup Chin (Korea), Hugo Geldres R. (Chile), J. Gayflor Kokro (Liberia), Romeo E. Lopez (El Salvador), W. B. Medagama (Sri Lanka), Mrs. Guia R. Minguez (Philippines), K. M. Mohapeloa (Lesotho), Gideon K. Onumah (Ghana), Hector Rayo C. (Nicaragua), M. A. Taha (Zambia), U Pe Maung Thein (Burma), and Enrique Villalobos R. (Costa Rica).

Eleven are sponsored by the U.S. Agency for International Development, two by national banks, one by the Food and Agriculture Organization, one by the Ford Foundation, and one by a university. Technical leader for the course is James B. Sinclair, Professor of Plant Pathology (UIUC). He is assisted by Mark T. Wall, a graduate student.

This is the second INTSOY short course of the year. The first, which was held in March and April, was entitled, "Soybean Processing for Food Uses." The level of enrollment, enthusiasm of participants, and general need for such courses have led to a tentative decision to offer both short courses again in 1976. If anyone is interested in participating or sponsoring a participant in either of the courses in 1976, please advise INTSOY immediately so that firm plans can be made.

PUBLICATIONS AVAILABLE

Single copies of *Economic Production Possibilities of Soybeans in Northern India: A Preliminary Study* by Folke Dovring, J. R. Jindia, and R. S. Misra are available free of charge from INTSOY. This is a report of a study made several years ago. It may be of interest from a methodological standpoint.

Also available are single copies of "Weaning Food Prepared From Whole Soybeans and Bananas by Drum Drying" by L. K. Ferrier, D. Bird, L. S. Wei, and A. I. Nelson. This is a reprint from "Nutritional Aspects of Common Beans and Other Legume Seeds as Animal and Human Foods" (*Archivos Latinamericanos de Nutrición,* Special Edition, 1975, W. G. Jaffé, Editor. Proceedings of a meeting held in Ribeirão Preto, Brasil, November, 1973.).

SOYBEAN CONFERENCE FOR ASIA AND OCEANIA

Announcements of the third INTSOY regional soybean conference have been sent to a number of scientists and institutions in Asia and Oceania. The conference will review all aspects of soybean production, protection, economics, and utilization and will be sponsored by INTSOY and the Asian Vegetable Research and Development Center (AVRDC). The conference probably will be held in Chiang Mai, Thailand, with the Government of Thailand as host sponsor.

The purposes of the conference are as follows:

1. To call attention to the importance of the direct uses of soybeans in human nutrition.
2. To bring together agricultural scientists of Asia and Oceania who are working with soybeans.
3. To encourage exchange of information among scientists from the region and around the world.

A list of persons wishing to attend the conference is now being compiled. Requests for an official invitation should be addressed to INTSOY, 113 Mumford Hall, University of Illinois, Urbana, Illinois 61801 USA, and should be received no later than October 15, 1975.

Funds are not available from INTSOY or AVRDC for expenses of conference participants. Individuals must arrange for travel and living expenses from resources available to them.

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NO. 6, NOVEMBER, 1975

SOYBEAN SEED STORAGE RESEARCH

Maintaining the germinability of soybean seed is a major concern in the development of soybeans as a crop in tropical and subtropical areas of the world. Soybeans that are to be used for seed must first be carefully harvested and dried to prevent damage that would cause a reduction in germination. The seed must then be stored under conditions that will minimize further damage.

Favorable conditions for soybean seed storage are 10°C and 50-percent relative humidity. These conditions can be provided easily, although at considerable expense, where sophisticated environmental control equipment can be obtained and serviced. In areas of the world where such equipment is economically or technically impractical, alternatives must be developed to meet soybean seed storage requirements.

Working under a grant from the Rockefeller Foundation in support of INTSOY activities, Assistant Professor Eliodoro J. Ravalo, Department of Agricultural Engineering, University of Puerto Rico, Mayagüez Campus, and Professor Errol D. Rodda, Department of Agricultural Engineering, University of Illinois at Urbana-Champaign, are studying the relationship between seed moisture content and storage condition requirements, with the cooperation of the agricultural engineering, agronomy, and plant pathology departments at both universities.

These studies are designed to evaluate the storage of soybean seed of various moisture contents under humid, tropical conditions. Woodworth seed with moisture contents of approximately 7, 10, and 13 percent prior to storage are being used. Samples are stored at Mayagüez and at Isabela in various containers: sealed tins, polyethylene bags in unsealed tins, fertilizer bags with a plastic lining, and cloth bags. The seed will be stored for periods of three, six, and nine months. Local average weather conditions are 25°C and 80-percent relative humidity. Samples having the same moisture contents are stored at Urbana in sealed tins under constant conditions corresponding to the average temperature and relative humidity in Puerto Rico.

A companion program is being conducted by M. D. Tedia as part of his Ph.D. thesis research in agronomy at UIUC under the direction of Dr. Carl N. Hittle. Mr. Tedia is studying the storage of soybean seed of various moisture contents under constant laboratory conditions that represent two climatic conditions to which soybean seed would be subjected during storage in central India.

Before storage, seed lots are conditioned to moisture contents of 7, 10, and 13 percent. Samples taken from each of these lots are then stored at either 25°C and 35-percent relative humidity (representing mean conditions) or 35°C and 35-percent relative humidity (representing hot weather conditions). Samples are packaged in heat-sealed polyethylene bags of 1-, 5-, and 8-mil thicknesses, and also in sealed tins. Evaluations will be made at intervals of two, four, and six months.

The INTSOY soybean seed research program has concentrated on storage without environmental control. However, environmental control can be provided in a relatively simple way in the humid tropics where reduction of temperature and humidity is always required. It is necessary only that electric power be available and that equipment can be serviced on an exchange basis. For example, a large window air conditioner can be used to control the temperature in an insulated room. Humidity can be controlled by a small desiccant dehumidifier operated independently by a humidistat. In most cases, however, the temperature control on the air conditioner will need improvement to prevent excessive cycling of the humidistat and icing of the air conditioner cooling coils.

The first professional paper on the current soybean seed storage research program will be presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers to be held December 15-18 at the Palmer House, Chicago, Illinois. The complete citation is ASAE Paper No. 75-3509, "Soybean Seed Vigor and Viability Under Various Storage Conditions," M. D. Tedia, graduate research assistant, Agronomy Department; E. D. Rodda, professor, Agricultural Engineering Department; and C. N. Hittle, professor, Agronomy Department, University of Illinois, Urbana, Illinois 61801.

Anyone with soybean storage problems or research and field experience in storage of soybeans under small-farm tropical conditions is invited to exchange information with INTSOY.

ISVEX — 76

The fourth International Soybean Variety Evaluation Experiment (ISVEX) is now being organized. Soybean researchers wishing to cooperate with INTSOY on this program in 1976 should submit their requests now, supplying the following essential information:

(1) Name, latitude, and altitude of sites where trials will be tested;
(2) Planting dates for each site;
(3) Address where trial is to be shipped;
(4) Name of nearest international airport; and
(5) Import and phytosanitary restrictions.

Requests will be screened to eliminate duplication within countries. Send all information to D. K. Whigham, Department of Agronomy, University of Illinois at Urbana-Champaign, N-507 Turner Hall, Urbana, Illinois 61801 USA.

MEMORANDA OF UNDERSTANDING PROMOTE COOPERATION

A promising vehicle for expansion of INTSOY's research and outreach activities is a series of memoranda of understanding enacted between the University of Illinois at Urbana-Champaign and institutions in Puerto Rico, Asia, Africa, and South America. The cooperating parties strive to promote the following objectives:

(1) To develop cooperative activities in furtherance of the common interests of the two parties;
(2) To develop research and research-related activities of mutual interest;
(3) To participate in cooperative research and educational endeavors to meet human needs;
(4) To enlarge and strengthen the capabilities and capacities of each party through the cooperative use of materials and facilities that are supportive of programs mutually agreed upon;
(5) To promote the exchange of scientists and students between the two for research, education, and training; and
(6) To facilitate the exchange of scholarly information and materials.

Memoranda of Understanding have been enacted between UIUC and the University of Puerto Rico, Mayagüez Campus; Fundação Instituto Agronômico do Paraná (IAPAR), Brasil; the Office of Rural Development, Ministry of Agriculture and Fisheries, Korea; and the Asian Vegetable Research and Development Center (AVRDC), Taiwan. Agreements also are under consideration with other international research centers working with soybeans.

Separate letters of agreement are issued for each jointly planned and approved project. Liaison officers are responsible for coordinating project proposals and activities. The agreements are not limited to INTSOY or to the College of Agriculture, and we anticipate the development of projects with other UIUC units in the future.

PUBLICATIONS OF INTEREST

Number 8 in the INTSOY Publications Series is now available. *International Soybean Variety Experiment, First Report of Results* by D. K. Whigham summarizes the results of experiments conducted from 1973 to 1974 at 60 sites in 27 countries. Copies of the report have been mailed to those who cooperated in the research. Single copies can be obtained free of charge by writing to INTSOY.

Two additional publications will be available in December. INTSOY Series Number 7, *An Annotated Bibliography of Soybean Diseases* by J. B. Sinclair and O. D. Dhingra, lists over 2,000 citations dating from 1882. The authors' original abstracts have been used whenever possible. The size and cost of this publication require that US $12.00 be charged. Send orders to INTSOY.

A Compendium of Soybean Diseases edited by J. B. Sinclair and M. C. Shurtleff also will be available in December. This 80-page digest was sponsored by the American Phytopathological Society; the American Soybean Association; INTSOY, the Illinois Cooperative Extension Service, and the Department of Plant Pathology, UIUC; and the U.S. Department of Agriculture. It is priced at US $6.00 per copy and can be ordered from the American Phytopathological Society, 3340 Pilot Knob Road, St. Paul, Minnesota 55121 USA.

REGIONAL SOYBEAN CONFERENCE — THAILAND

Response to the announcement of the Third Regional Soybean Conference to be held in Chiangmai, Thailand, February 23-26, 1976, has been excellent. Over 140 invitations have been extended to prospective participants, and requests for invitations are received daily. Nearly all invited speakers have responded affirmatively. Staffs of the several cooperating agricultural organizations in Thailand, the Asian Vegetable Research and Development Center, and INTSOY hope to make this conference the most successful one yet.

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NO. 7, FEBRUARY, 1976

INTSOY GENETIC IMPROVEMENT PROGRAM

To identify or develop high-yielding, highly nutritious soybean varieties that are suitable for tropical and subtropical zones is the primary goal of INTSOY's soybean improvement program. While INTSOY is concerned with all aspects of soybeans, from production to consumption, genetic improvement of soybean varieties is a major interest.

The genetic improvement program is founded upon a strategy that calls for (1) testing of existing, improved varieties under many environmental conditions, (2) identification of traits that will improve the adaptation and productivity of these varieties in tropical and subtropical climates, (3) introduction of these desirable traits into existing varieties, and (4) establishment of linkages among soybean breeders that will enhance generation, testing, and use of these improved varieties. Each phase relies heavily upon the cooperation of scientists around the world.

Implementation of this strategy was given impetus in 1973 by the establishment of the International Soybean Variety Evaluation Experiment (ISVEX). The experiment was designed to (1) evaluate soybean performance under different environmental conditions, (2) identify areas of the world that have a potential for soybean production, (3) provide an opportunity for researchers to compare local and introduced varieties, and (4) make available a source of new germplasm to cooperating scientists.

In the first two years of the ISVEX program, the same set of varieties from the United States was tested at all locations. Results from these trials helped to identify varieties that perform well within certain climatic zones. Consequently, in 1975 one set of entries, composed of varieties from U.S. Maturity Groups III through IX, was distributed to all tropical and subtropical zones. A different set, including varieties from U.S. Maturity Groups 00 through V, was distributed to the temperate zones. These experiments were conducted at 245 locations in 90 countries, ranging in latitude from 35°S. to 45°N. and in altitude from 0 to 2,000 meters. This year six different sets of varieties, having a few entries in common, will be distributed. ISVEX has increased the genetic resource base for cooperative research, and will provide, over a period of time, much of the information needed to guide INTSOY's soybean improvement program.

Modified soybean variety experiments similar to ISVEX are being conducted cooperatively with the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) in the Philippines, Indonesia, and Thailand and with the International Institute of Tropical Agriculture (IITA) in African countries between the latitudes of 20°N. and 20°S. Cooperative relationships such as these between institutions engaged in soybean research help to reduce unnecessary duplication of experiments.

The establishment in 1974 of a soybean breeding program using personnel and facilities of the University of Puerto Rico, Mayagüez Campus, initiated another phase of INTSOY's soybean improvement strategy. The objective of this breeding program is to combine desirable agronomic characters found in improved varieties showing good ecological adaptation to the tropics and resistance to major diseases and insect pests. As improved nutritional qualities are identified, their incorporation into tropically adapted varieties will be emphasized.

Lines and varieties adapted to the tropics have been crossed with varieties that performed well in the ISVEX trials. Accessions from the United States Department of Agriculture germplasm collection site at Stoneville, Mississippi, are now being evaluated in Puerto Rico. About 400 lines from the latest maturity groups have undergone preliminary evaluation. These lines are being tested for resistance to seedborne pathogens causing deterioration in seed quality, especially in the tropics. Cultivars possessing various degrees of photoperiod sensitivity have been identified and crossed with sensitive types to study the inheritance of photoperiod insensitivity and its relationship to maturity and other agronomic traits. A highly heritable source of insensitivity to daylength would greatly facilitate the transfer of traits from temperate to tropical varieties.

Advanced, heterogeneous populations from this breeding program will be released to cooperating scientists around the world. It is expected that each scientist will be able to select high-yielding cultivars adapted to his environmental conditions from these populations. Homozygous lines will also be selected for testing in a wide range of environments.

To test these experimental lines as well as superior cultivars and lines from other sources, the Soybean Preliminary Observation Trial (SPOT) is being

established. SPOT will be conducted in 1976 at a small number of sites chosen to represent important environments in the tropics and subtropics. This aspect of the breeding program will become increasingly important as genetic materials become available in sufficient quantities to permit wide distribution.

INTSOY personnel in several disciplines besides plant breeding contribute to the attainment of soybean improvement goals. Basic research is being conducted by INTSOY food technologists and other researchers at the University of Illinois at Urbana-Champaign to identify sources of characteristics that will enhance the cooking and nutritional properties of the soybean. INTSOY pathologists are identifying diseases that occur in soybeans in the tropics and subtropics and are assisting in the search for genetic resistance to the more important ones. Currently, they are concentrating on virus diseases and seed-borne pathogens. Similarly, INTSOY entomologists are identifying the most important soybean pests and assisting in the development of insect-resistant soybean varieties. To the extent possible, the activities of these scientists are planned to supplement research being conducted by others.

INTSOY OUTREACH PROGRAM

In addition to operations in Puerto Rico and in other countries participating in such programs as ISVEX and SPOT (see page one), INTSOY is conducting special projects in several countries under a number of funding arrangements.

The largest of these special projects in terms of scope, manpower, and resources is a 2½-year project in Sri Lanka. Supported by the United Nations Development Program through the Food and Agriculture Organization, INTSOY is assisting the Central Agricultural Research Institute of Sri Lanka in a national soybean development program. This program focuses upon soybean production, protection, and economics as well as utilization of soybeans in the diets of both rural and urban poor.

The U.S. Agency for International Development, through a series of task orders, has also supported INTSOY work in a number of countries requesting an array of advice and services related to soybean development. Projects in Guyana, Bangladesh, and Zaire have been completed. Three projects are currently in operation in Peru, Ecuador, and Thailand.

A central feature of the INTSOY outreach program has been the ability to assemble teams of highly qualified personnel from the developing international network of soybean scientists. The projects mentioned above will be the subject of a feature article in a subsequent newsletter.

THAILAND REGIONAL CONFERENCE

"Expanding the Use of Soybeans" was the theme of the highly successful Third Regional Soybean Conference for scientists in Asia and Oceania, which was held in Chiangmai, Thailand, February 23 through February 27. Sponsored by the Government of Thailand, the Asian Vegetable Research and Development Center, and INTSOY and supported by the U.S. Agency for International Development, the conference was attended by about 225 participants from 21 countries.

General sessions were devoted to presentation of 28 papers on various aspects of production, protection, utilization, and economics. Symposia on soybean rust, breeding tropical soybeans, small-scale soybean processing, and extension of research to the village farmer were conducted. Reports summarizing soybean activities were given by designated country reporters. Field trips to the facilities of the Faculty of Agriculture, Chiangmai University, to farms and villages cooperating in the Ford Foundation Multiple Cropping Project, and to the Mae Joe Experiment Station were well attended on the final day of the conference.

Proceedings of the conference will be available in the INTSOY Publications Series later this year. The editor will be Dr. Robert M. Goodman, conference chairman.

SHORT COURSE OUTLOOK

Nominations for the short course on "Technical and Economic Aspects of Soybean Production," to be held May 5 through August 26, 1976, are being received at an increasing rate. Enrollment will be limited to 25 persons, and we anticipate more nominations than facilities and staff can accommodate. If you are interested in being a participant or in sponsoring someone, please submit nominations directly to INTSOY or through the U.S. Agency for International Development mission or the Food and Agriculture Organization representative in your country.

NEW PUBLICATION

Number 9 in the INTSOY Publication Series is now available. *Soybean Cultivars Released in the United States and Canada: Morphological Descriptions and Responses to Selected Foliar, Stem, and Root Diseases* by T. Hymowitz, S. G. Carmer, and C. A. Newell contains information about 331 cultivars and will be of special interest to soybean breeders and pathologists. Single copies can be obtained free of charge by writing to INTSOY.

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NO. 8, MAY, 1976

INTSOY COUNTRY OUTREACH PROGRAM

INTSOY serves as the hub of the international soybean network, cooperating with international and national organizations to expand the use of soybeans for human food. Many activities are carried out informally with cooperating scientists. An example is the International Soybean Variety Evaluation Experiment (ISVEX). Initiated in 1973, it has now expanded to 257 locations in 90 countries. A more formal mechanism for cooperation with international centers and national organizations is provided through memoranda of understanding and letters of agreement. (See *Newsletter No. 6.*)

Newsletter No. 7 provided an overview of INTSOY's special country outreach programs and promised additional information to illustrate the types of services that can be provided by teams of highly qualified personnel from the developing international network of soybean scientists.

The Sri Lanka soybean development program, the largest of the special projects, is supported by the United Nations Development Program through the Food and Agriculture Organization. The initial, 2½-year phase of the program, which began in April, 1975, will provide 88 man-months of long- and short-term expert assistance and 187 man-months of training. A large part of the training is being done at G. B. Pant University of Agriculture and Technology, Uttar Pradesh, India, and at the University of Illinois at Urbana-Champaign in INTSOY processing and production training courses.

Project leader C. N. Hittle, agronomy; A. I. Nelson, food science; S. W. Williams, agricultural economics; and E. D. Rodda, agricultural engineering, have served on short assignments in Sri Lanka since the project began. R. W. Howell, agronomy; R. E. Ford, plant pathology; and T. A. McCowen and W. N. Thompson, INTSOY administration, have served on short executive and technical visits. All are members of the UIUC staff.

Several national governments have received funding for cooperative INTSOY work in their countries from the U.S. Agency for International Development (USAID). Projects of short and intermediate duration have been completed in Guyana, Peru, Bangladesh, Uruguay, and Zaire. In Guyana, INTSOY provided 10 months of technical assistance in the areas of agronomy, plant breeding, costs of production and marketing, seed technology, microbiology, processing (separation of oil and protein), and food science (utilization). Single-man "teams" evaluated the potential for soybean production in Peru, Bangladesh, and Uruguay. INTSOY joined Cornell University and USAID in forming a three-man team, which reviewed a project under consideration in Zaire in October, 1975.

In Peru, as a follow-up to the project reported above, INTSOY is now assisting the Government of Peru in improving the management of human and financial resources for more effective performance in a program of soybean research, utilization, production, and marketing. Twenty-two man-months of expert assistance are being provided. In September and October of 1975, a six-man team conducted a program survey and submitted their preliminary report, "Potentials for Soybean Development in Peru." The team was composed of C. N. Hittle, A. I. Nelson, and S. W. Williams of the INTSOY core staff at Urbana-Champaign; INTSOY Associate Director Raul Abrams of the University of Puerto Rico, Mayagüez Campus; W. M. Sager of the Illinois Cooperative Extension Service; and R. S. Smith of Agricultural Laboratories, Inc., Columbus, Ohio. Hittle, Nelson, and Sager made another trip to Peru in early 1976. A. G. Harms, agricultural economics, UIUC, also served on a brief assignment in Peru in early 1976.

In another South American country, Ecuador, an INTSOY team is assisting the government in developing an improved soybean production program by designing packages of recommended production practices appropriate to farmers' environments. A five-man team has been formed, consisting of E. H. Paschal II, INTSOY plant breeder stationed at the University of Puerto Rico, Mayagüez Campus; M. E. Irwin, INTSOY pest management specialist, and J. B. Sinclair, INTSOY seed pathologist, both of the University of Illinois at Urbana-Champaign; Pedro Meléndez, plant pathologist, University of Puerto Rico, Mayagüez Campus; and Noble Usherwood of The Potash Institute, Atlanta, Georgia. In November, 1975, Paschal and Usherwood made an initial visit and presented a preliminary report for government consideration. Paschal and Sinclair made a follow-up visit in May.

The objective of a third country project is to conduct a feasibility study dealing with the inoculant component of a comprehensive seed development project to be undertaken by the Government of Thailand. INTSOY was fortunate to be able to recruit a two-man team from an associated university to provide the 3 man-months of service the study required. R. H. Weaver, soil microbiologist, and H. M. Richards, economist, both of Texas A. & M. University, conducted the initial phase of the study in Thailand in early January, 1976. Weaver will complete the study with a follow-up visit in June.

C. N. HITTLE TO SRI LANKA

C. N. Hittle will begin a long-term assignment in Sri Lanka on July 1, serving as Project Manager/ Senior Adviser and Soybean Production Agronomist on the soybean development project supported by the United Nations Development Program and the Food and Agriculture Organization. He will also serve as INTSOY representative for Asia. Correspondence to him should be addressed to INTSOY, Central Agricultural Research Institute, Gannoruwa, Peradeniya, Sri Lanka.

SOYBEAN DISEASES SLIDE SET AVAILABLE

A set of 42 color slides [5 x 5 cm (2 x 2 inches)] illustrating the major diseases of soybeans and general control methods is now available. A brochure explaining each slide accompanies the set. Orders can be placed through INTSOY or by writing to the Vocational Agriculture Service, University of Illinois at Urbana-Champaign, 434 Mumford Hall, Urbana, Illinois 61801 USA. The price for a single slide set and a brochure is US $7.40 plus postage.

USAID EXTENDS SUPPORT OF INTSOY

Since April, 1973, the primary financial support for INTSOY research on production, protection, and use of soybeans for the rural and urban poor of the developing countries has been provided by the U.S. Agency for International Development. On March 31, 1976, a new agreement was signed extending the research efforts for an additional three years. The emphasis will remain on multidisciplinary research in varietal improvement for yield and quality, soybean pathology, and pest management. Work in Rhizobium inoculants and seed storage will be added.

TRAINING ACTIVITIES

We are approaching the midpoint of the April-to-August training session, during which two INTSOY short courses are offered. The courses, "Soybean Processing for Food Uses" and "Technical and Economic Aspects of Soybean Production," have been developed in cooperation with the International Training Office of the U.S. Department of Agriculture. Participants are supported primarily by the U.S. Agency for International Development, with additional study awards from the Food and Agriculture Organization; the Ford Foundation; and ministries, universities, and private firms in a number of countries. This is the second year for each of the courses, and attendance has increased.

Completing the processing course in early May were the following 15 participants from 12 countries: Mohammad Nabi Aslamy (Afghanistan), Abu Fazal Md. Asafzah (Bangladesh), Abdul Hamid Anwar Borai (Egypt), Wen-Lian Chen (Republic of China), Jorge Duran-Castro (Colombia), Fernando Moreno P. (Colombia), Ahmad Nabavi (Iran), O. O. Onyekwere (Nigeria), Mohamed Aly Shaker (Egypt), Shripati Sharma Vashistha (Nepal), João Shojiro Tango (Brasil), Alejandro Uribe Peralta (Colombia), Kailash Vyas (India), Wilmot Banda Wijeratne (Sri Lanka), and María Cristina Zulueta (Peru).

Messrs. Borai and Shaker are participating in both courses. On May 20, they were joined in the production course by the following 16 participants from 12 countries: Cyprian K. Bulungu (Uganda), Ben Emerson (Sri Lanka), Khanji Khalil (Syria), Owsu-Kwateng (Ghana), Hector Mercer-Quarshie (Ghana), Samir Michail (Egypt), Samia Aly Mohammad (Egypt), Miaswekama Nkusu (Zaire), Keun Yong Park (Korea), Luis Carlos Salazar (Panama), Abdul Hamid Sarker (Bangladesh), Abbas Hassan Shuwailiya (Iraq), Joseph Temba (Zambia), Gabriel Von Lindeman (Panama), Marja Vratarić (Yugoslavia), and N. Wijewarnasuriya (Sri Lanka). Still another Zairian, Kakule Masiki, is expected to join the group in June.

Technical leader for the processing course was A. I. Nelson, professor of food processing, University of Illinois at Urbana-Champaign, assisted by L. K. Ferrier, assistant professor of food science, UIUC. H. C. Minor, assistant professor of agronomy, UIUC, is technical leader for the production course. He is assisted by S. D. Litherland, a May graduate of the College of Agriculture, UIUC.

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NO. 9, AUGUST, 1976

INTSOY TRAINING PROGRAM

Training students from many nations in the development of soybeans for human food has assumed a major role in the INTSOY program. The program offers several types of instruction, including structured courses, informal workshops, and assistance on an individual basis.

Since 1975, INTSOY has sponsored two, short-term applied soybean training courses. The courses were developed in cooperation with the United States Department of Agriculture's Office of International Training, the U.S. Agency for International Development, the Food and Agriculture Organization, and other donor groups. Sixty-one persons from 33 countries have received training in the two courses, and both will be offered again in 1977.

"Soybean Processing for Food Uses," a six-week course, is designed to give students the opportunity to learn the principles and processes involved in the use of soybeans and soybean products for human foods, to teach them the concepts and procedures involved in processing whole soybeans, and to help students apply their knowledge to development objectives in their own countries.

In 1975, 13 persons from 10 countries completed the course. The students came from Brasil, Colombia, Costa Rica, Ghana, Kenya, Nicaragua, Philippines, South Korea, Sri Lanka, and Thailand. The next year 15 students from 12 countries attended. These were from Afghanistan, Bangladesh, Brasil, Colombia, Egypt, India, Iran, Nepal, Nigeria, Peru, Republic of China, and Sri Lanka.

The other INTSOY short course, "Technical and Economic Aspects of Soybean Production," is of longer duration, lasting about four months. It spans the major part of the soybean growing season in the United States. The objectives of the course are to teach the technical and economic principles and practices of soybean production; to promote understanding of the potential use of soybeans to alleviate protein and calorie deficiencies; to increase students' knowledge of the soybean plant itself, the cultural practices required for its production, factors affecting seed quality, and methods of adapting technology to local conditions; and to study research, educational, and regulatory functions supportive of a soybean industry.

Sixteen persons from 15 countries completed the course the first year. Represented in this group were Burma, Chile, Costa Rica, El Salvador, Ghana, Iran, Jamaica, Lesotho, Liberia, Nicaragua, Philippines, South Korea, Sri Lanka, Uruguay, and Zambia. The second year 19 participants from 12 countries attended. These students were from Bangladesh, Egypt, Ghana, Iraq, Panama, South Korea, Sri Lanka, Syria, Uganda, Yugoslavia, Zaire, and Zambia.

Dates have already been set for the 1977 series of courses. The processing course will be held March 24-May 4, and the production course will be April 27-August 4.

As the training program expands, more attention is being given to overseas training. The overseas program is expected to begin in late 1976, when INTSOY personnel will offer one-week soybean extension workshops in Peru and Ecuador under USAID Task Order arrangements. Plans are also under way to offer a condensed version of the soybean production short course at selected overseas locations. The objective of the course will be to provide participants with an adequate understanding of the soybean crop and its management and to teach them to recognize production hazards and to evaluate the consequences of these hazards in terms of soybean productivity and quality. The USDA Office of International Training is cooperating in the development of the course, which may be offered in 1977.

While short courses have provided formal training, INTSOY regional soybean conferences have brought soybean scientists together for informal training and exchange of information and research findings. In the last three years, a separate conference has been held for soybean workers in each of the following three regions: Latin America and the Caribbean; Africa, the Middle East, and South Asia; and Asia and Oceania.

The purpose of each conference was to consider the potential of soybeans as a major world food crop. General sessions were devoted to the presentation of scientific papers on various aspects of production, protection, economics, and utilization. Two of the conferences featured symposia on special problems associated with soybean production, protection, or use. Field trips to experiment stations were included

in all. Reports from each country represented at the conferences provided an opportunity to compare plans, activities, and programs.

The conferences were well attended. Seventy-one participants from 12 countries attended the first conference, held February 4-6, 1974, at the University of Puerto Rico, Mayagüez Campus. The second conference, held October 14-17, 1974, in Addis Ababa, Ethiopia, attracted 97 participants from 24 countries. The most recent conference, held February 23-27, 1976, in Chiang Mai, Thailand, was attended by 225 participants from 21 countries.

The regional conferences have been a very effective means of encouraging the exchange of ideas and information across national lines. Proceedings of the first two conferences (INTSOY Series Numbers 2 and 6) are frequently requested. Proceedings of the third conference (INTSOY Series Number 10) will be available in late fall.

When the instructional needs of a particular individual or group cannot be met through the training programs outlined above, INTSOY responds with more specialized assistance. For example, an eight-man study team from the Oilseed Research and Development Company, Teheran, Iran, recently completed a three-week training program designed to familiarize them with various aspects of the American soybean industry. In September, six ministry representatives from Peru will come to the University of Illinois for a similar program, part of which will be conducted at the University of Puerto Rico, Mayagüez Campus. Requests for this type of assistance are increasing, and INTSOY will respond to the extent that its resources allow.

RESEARCH CONTRACT REPORT

A final report entitled "Development of Improved Varieties of Soybeans" was forwarded to the U.S. Agency for International Development upon completion of a three-year AID-sponsored contract. The 143-page report describes accomplishments in soybean variety development, insect control and entomology, soybean pathology, and soybean food uses. A limited number of copies are available. Interested persons should write to INTSOY.

INTSOY PROFESSIONAL STAFF

The first issue of the Newsletter (August, 1974) included a listing of the professional personnel identified as INTSOY core staff. During the intervening period, the makeup of that group has changed. As of August, 1976, the INTSOY professional staff included the following persons:

Administration

William N. Thompson, Director
Raúl Abrams,* Associate Director
Thomas A. McCowen, Assistant Director

Production

Robert E. Dunker, Assistant Agronomist, Field Trials
Carl N. Hittle,** Soybean Breeding
Harry C. Minor, Breeder/Agronomist — SPOT
E. Hamer Paschal, II,* Soybean Breeding
Eliodoro Ravalo, Seed Storage
Errol D. Rodda, Agricultural Engineering
D. Keith Whigham, Agronomist — ISVEX

Protection

Michael Ellis,* Soybean Pathology
Robert M. Goodman, Soybean Virologist
Michael E. Irwin, Insect Pest Management
Pedro Meléndez,* Soybean Fungal Diseases
Guillermo Riveros,* Soybean Weed Control
James B. Sinclair, Soybean Fungal and Bacterial Diseases

Marketing, Processing, and Use

Leslie K. Ferrier, Food Chemistry
Alvin I. Nelson, Food Processing
Frances O. Van Duyne, Nutrition and Soybean Foods
Sheldon W. Williams, Marketing and Processing Economics

Many other University of Illinois and University of Puerto Rico staff members, research assistants, and supporting personnel contribute to the many aspects of the International Soybean Program (INTSOY).

* Located at the University of Puerto Rico, Mayagüez Campus.
** Located at Kandy, Sri Lanka, as Project Leader and INTSOY Representative for Asia.

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NO. 10, FEBRUARY, 1977

INTSOY — SOME QUESTIONS AND ANSWERS

Readers of the *INTSOY Newsletter* since it was started in August, 1974, know that the main purpose of the *Newsletter* is to provide information on INTSOY's mission, organization, program, and activities. Several hundred names have been added to the mailing list since the first issue explained that "INTSOY is concerned with all phases of soybeans from planting the seed to consumption. These phases include production, harvesting, marketing, processing, and utilization. INTSOY's major interest is in the exploitation of the unique potential of soybeans as a source of protein for direct human consumption. Research centers primarily on the problems of tropical and subtropical environments but is also concerned with nutrition and processing as ways to expand use of soybean protein foods in human diets."

Since being formally established in 1973 with the mission of "expanding the use of soybeans for human food," INTSOY has been taking the leadership, on an international scale, in soybean research, education, and development work. Organizational flexibility has fostered the development of a network of organizations and individuals whose objectives coincide with the INTSOY mission.

This issue will provide brief answers to some recurring questions about INTSOY.

Is INTSOY's interest limited to the tropics and subtropics? No. There are no geographical constraints on the international soybean network; however, attention is focused on the expanded use of soybeans as a source of protein and energy among low-income people, who are concentrated in, but not limited to, tropical and subtropical areas.

Why does INTSOY emphasize use of whole soybean foods? INTSOY and other food scientists have developed simple and straightforward methods of preparing whole soybeans and combining them with other food ingredients such as cereals. Use of whole soybeans eliminates the costs of separating the protein and oil components. However, this emphasis does not preclude attention being given to use of soybeans in other ways (for example, as soybean oil and protein concentrates following expeller or solvent extraction). Experience has shown the versatility of the soybean in many different human foods, livestock feed, and industrial uses. The best combination of uses will vary from country to country and from time to time.

Are soybeans adapted to small farm conditions? Yes. Many people think of soybeans as a crop for large, commercialized farms, probably because of their association with countries such as the United States and Brasil. Soybeans have been grown under small farm conditions in China for centuries. They are currently grown on small farms in a number of other countries, including Colombia, India, Indonesia, Iran, Japan, Korea, Nigeria, Taiwan, and Thailand. Soybeans seem to be as well adapted to small farm conditions as is any other crop. INTSOY research emphasizes improved genetic technology, which is independent of farm size.

Is INTSOY an international research center? Yes and no. While INTSOY's objectives are similar to those of the international research centers that have been recognized by and supported through the Consultative Group on International Agricultural Research, INTSOY has not been recognized by this group. On the other hand, INTSOY has been rapidly evolving as the leading research and education organization in the development of an *international soybean network* that includes not only the Universities of Illinois and Puerto Rico, but national, regional, and international organizations cooperating in an overall program to fully exploit the potentials of soybeans as a source of food.

NEW PUBLICATIONS

Numbers 10 and 11 in the INTSOY Publication Series are now available. Number 10 is *Expanding the Use of Soybeans, Proceedings of a Conference for Asia and Oceania* by R. M. Goodman, editor. This publication contains 29 general session papers, notes on 5 symposia, and 12 country reports presented at the regional conference held in Chiang Mai, Thailand, and sponsored by the Government of Thailand, the Asian Vegetable Research and Development Center, and INTSOY in February, 1976.

Number 11, *International Soybean Variety Experiment, Second Report of Results* by D. K. Whigham, summarizes the results of experiments conducted from 1974 to 1975 at 86 sites in 39 countries. Copies

of this report have been mailed to those who cooperated in the research.

Single copies of each publication can be obtained free of charge by writing to INTSOY.

OUTREACH — ZAIRE AND GHANA

During November, 1976, three University of Illinois INTSOY staff members worked with a representative of the U.S. Agency for International Development (USAID) in providing technical expertise in support of a project in Zaire to improve the quantity and quality of food production, especially the production of legumes, through Zaire's National Institute of Agricultural Research.

Joseph A. Jackobs (agronomy), John W. Matthews (agricultural engineering), and Russell T. Odell (soils) collaborated with AID's Jiryis S. Oweis and filed their report with the AID mission director prior to departure from Zaire.

In January and February, 1977, a four-man INTSOY team worked with the Government of Ghana and USAID representatives in designing a five-year national program for soybean production, processing, and utilization. A. G. Harms (agricultural economics), Joseph A. Jackobs (agronomy), Paul G. Klinefelter (food processing), and Elwood F. Olver (agricultural engineering) comprised the study mission, whose recommendations are now under consideration by the Government of Ghana.

TRAINING COURSES, 1977

Once again, in collaboration with the U.S. Department of Agriculture and the U.S. Agency for International Development, training courses in soybean processing and production will be offered. "Soybean Processing for Food Uses" will get under way in Urbana-Champaign March 23, after a brief orientation in Washington, D.C., for AID-sponsored participants. Four weeks of intensive classroom and laboratory work, a week-long study tour, and a brief presentation of reports will fully occupy the participants' schedules until departure from the Illinois campus May 3 or 4.

There is still time to request seats in the summer-long course, "Technical and Economic Aspects of Soybean Production," commencing on the Urbana-Champaign campus May 12 and continuing through August 19, but requests should be made soon to assure space. Participants in both courses must be sponsored by their institutions or governments, AID, FAO, foundations, or other sponsoring organizations. INTSOY has no scholarship funds at its disposal.

ASIAN SOYBEAN RUST WORKSHOP

February 27 through March 4, 1977, are the dates for a workshop on soybean rust to be hosted by the Philippine Council for Agriculture and Resources Research, Los Baños. INTSOY and the Asian Vegetable Research and Development Center are sponsoring the workshop, which has been planned by the International Soybean Rust Working Group. Participation will be limited to a small group who have been invited to assist in planning research and educational strategies for control of the disease.

PCARR–INTSOY MEMORANDUM OF UNDERSTANDING

The Philippine Council for Agriculture and Resources Research and INTSOY have completed a Memorandum of Understanding providing for cooperative soybean research and educational work. The Asian Soybean Rust Workshop is the first activity to be conducted under this memorandum.

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NO. 11, MAY, 1977

ASIA-OCEANIA SOYBEAN RUST WORKSHOP

Soybean rust poses a serious economic threat to soybean production areas, particularly in the Eastern Hemisphere. A systematic, coordinated research program is urgently needed for many of the Asian and Oceanian countries where the disease occurs. The first Workshop on Soybean Rust was convened in Manila, the Philippines, from February 27 through March 4, 1977, to organize such a program. The workshop was cosponsored by the Asian Vegetable Research and Development Center (AVRDC), the Philippine Council for Agriculture and Resources Research (PCARR), and INTSOY.

Widely distributed, soybean rust has been reported by almost all countries in the Eastern Hemisphere, including Australia and the U.S.S.R. Rust is destructive in most soybean-growing areas of the East. Thailand has reported yield losses of 10 to 40 percent in local cultivars and complete yield loss in some imported cultivars. Taiwan has experienced losses up to 50 percent. All of the commercial soybean cultivars grown in the Western Hemisphere, including the United States and Brasil, are susceptible. There are at least 20 different leguminous hosts of the soybean rust pathogen. Evidence indicates that there may be more than one race of the organism.

More than 30 participants from Australia, India, Indonesia, Korea, the Philippines, Taiwan, Thailand, and the United States attended the Workshop on Soybean Rust. Representatives of these countries presented status reports on soybean rust and the efforts to combat it through breeding, chemical and biological control, or other methods. These reports, which are a valuable addition to research related to soybean rust, will be available in the INTSOY publication series later this year.

Workshop participants agreed that a cooperative research program should be started as soon as possible. A team was selected to prepare a comprehensive proposal to submit to national and international funding agencies. The proposal is not yet ready to be reviewed by the participants, but it will include program recommendations for (1) facilitating the understanding of rust and rust control practices; (2) developing interdisciplinary research and a communications network for disseminating findings; (3) initiating and expanding rust control training programs; (4) increasing advisory and extension capabilities; and (5) establishing soybean rust nurseries to study the etiology of rust and the reaction of soybean varieties to the disease, to develop biological and chemical control measures, and to screen local rust-resistant varieties and advanced breeding lines under natural and artificially created epiphytotic conditions.

Special appreciation for their planning and leadership is extended to the PCARR Secretariat and to Richard E. Ford, Workshop Chairman and Head of the Department of Plant Pathology, University of Illinois at Urbana-Champaign.

SOYBEAN PROCESSING COURSE COMPLETED

Congratulations to the 11 graduates of the INTSOY-sponsored short course, "Soybean Processing for Food Uses." At a May 3 ceremony Orville G. Bentley, Dean of the College of Agriculture, University of Illinois, presented certificates to the following: Oscar Moreno-Gómez and Efrain Hernan Taborda (Colombia); Ildefonso Bohorquez and Wilma Freiere (Ecuador); Abdel Monem El-Mehelmy, Raafat Fawzi Eskander, and Mostafa Ahmed Soliman (Egypt); Irma Argentina Mejía (Honduras); Ahmad Firouzi (Iran); Hussin Zakaria (Malaysia); and Shiva Kumar Chaudhary (Nepal).

Leaders for the course were Leslie K. Ferrier, A. I. Nelson, and colleagues in the Department of Food Science, University of Illinois at Urbana-Champaign. This is the third time that the course has been offered.

SOYBEAN PRODUCTION COURSE BEGINS

Classes began on May 16 for another training session, "Technical and Economic Aspects of Soybean Production." This course, the third of its kind, is designed to acquaint students from developing countries with (1) the technical and economic principles and practices of soybean production; (2) the research, educational, and regulatory functions supportive of a soybean industry, and (3) the use of soybeans to alleviate protein and calorie deficiencies in the developing world.

The following 11 people enrolled: Cecil Dharmasena, A. K. S. Besley Jinendradasa, and J. Mahendrasena (Sri Lanka); Heshmatollah Pourdavai (Iran); S. K. Chaudhary and R. P. Chaudhary (Nepal); Novianti Sunarlim (Indonesia); Mahmoud Kalaji (Syria); Ignace H. Gwau (Tanzania); Driss Nadah (Morocco); and Ho Il Kim (Korea).

Harry C. Minor, Assistant Professor of Agronomy, is serving as technical leader, and Henry J. Hill, Assistant Agronomist, is working with him.

INTSOY STAFF CHANGES

Within the past few months several INTSOY staff changes have occurred. Robert E. Dunker, Assistant Agronomist for Field Trials, has transferred from the University of Illinois at Urbana-Champaign to the University of Puerto Rico, Mayagüez Campus, where he will work in cooperation with the expanding breeding program. Henry J. Hill has joined the INTSOY staff to assist with the International Soybean Variety Evaluation Experiment (ISVEX), the Soybean Preliminary Observation Trial (SPOT), and other activities at the University of Illinois.

D. Keith Whigham has left Illinois and INTSOY for a position at Iowa State University. In February at the second INTSOY staff retreat, a motion was unanimously adopted in recognition of the contributions that Keith has made in helping establish INTSOY "as an institution truly oriented toward international work."

William H. Judy and R. Stewart Smith will soon join the INTSOY staff. Dr. Judy comes to the program with considerable overseas experience in Africa and South Asia, where he worked for the Agricultural Research Service of the U.S. Department of Agriculture. Dr. Smith, who has served as consultant on INTSOY country projects, will leave Agricultural Laboratories, Columbus, Ohio, to begin work at the University of Puerto Rico, Mayagüez Campus. He will assume major responsibility for soybean microbiology and inoculum research.

A new position, International Training and Communications Specialist, is in the process of being filled. A search committee is accepting applications, and a choice will be made before the next issue of the INTSOY Newsletter is published.

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NO. 12, AUGUST, 1977

NEW INTSOY PROJECTS

According to Gershwin, summer is supposed to be a time "when the livin' is easy." Most staff members, and certainly those directly connected with INTSOY, would disagree. Many activities have made this summer hectic but challenging.

Three technical assistance projects are in the planning or implementation stage. One project, funded through a new two-year contract with the U.S. Agency for International Development (USAID), is designed to expand the cultivation of soybeans on small farms in high, tropical rain forest areas, to encourage the use of improved varities of highland corn in the mountains of Peru, and to increase the direct human consumption of improved corn, soybeans, and soybean products.

A shorter-range project, conducted under a contract issued by the USAID Mission to Panama, will assist the faculty of agriculture at the University of Panama in developing research programs in oilseed crops, especially soybeans. During the next five months this project will require about two man-months of effort. Another short-term project, requested and supported by the Food and Agriculture Organization (FAO), will appraise soybean potential in Iraq. A two-man mission lasting about three weeks will begin in late September.

PROGRAM DEVELOPMENT

Program development activities were highlighted this spring and summer. In late May INTSOY sponsored an International Soybean Network Conference at the University of Illinois at Urbana-Champaign. The primary purpose of the conference was to make plans for broadening participation by U.S. organizations and to consider ways of improving organizational and administrative mechanisms. Eleven U.S. universities, as well as national and international organizations, sent representatives. Since the conference, several U.S. universities have expressed strong interest in joining forces with INTSOY to widen the research and training base from which to attack protein-calorie deficiency problems in developing nations.

A preliminary Title XII proposal and a request for a Title XII proposal planning grant were submitted to the Board for International Food and Agricultural Development and to USAID. If the planning grant is approved, the funds will be used to coordinate the research and training activities of U.S. institutions that want to join in the international soybean effort.

In late July INTSOY participated in a second ad hoc consultation at FAO, Rome, to consider ways to guide and coordinate research and research-related training efforts of autonomous but cooperating institutions. Members of the group developed a proposal to establish an international board for soybean research. This proposal will be reviewed by the Technical Advisory Committee to the Consultative Group on International Agricultural Research.

TRAINING ACTIVITIES

Training and visitation programs have kept the INTSOY staff busy. The third annual short course on "Technical and Economic Aspects of Soybean Production" ended on August 19. Eleven participants from eight countries under five different forms of sponsorship spent fourteen weeks at the University of Illinois at Urbana-Champaign learning about soybean growth and development. In late July sixteen soybean workers, including seven farmers, from the Iran Oilseed Research and Development Company were briefed on soybean farming practices in East Central Illinois. After the orientation the team from Iran joined the short-course participants for an extensive tour of soybean research and production centers in the southern states.

During July, two groups of agriculturalists from the Soviet Union, including the Deputy Minister for Agriculture, were briefed on INTSOY program activities. In addition, plans have been developed for forty to sixty Argentine farmers to visit during the soybean harvesting season.

ANNOUNCEMENTS

The Far East Office of the American Soybean Association is organizing an International Soya Protein Food Conference to be held at the Mandarin Hotel, Singapore, January 25 to 27, 1978. The conference is for the entire Eastern Hemisphere, and

will be geared to nutrition research workers and teachers, food industry specialists, and people influential in the formation of national food policies. The conference will draw on the expertise of university, government, and food industry nutrition specialists from the United States, Japan, and many other countries participating in the conference.

There will be a registration fee; for the most part participants will pay their own expenses. For more information contact one of the following: Lloyd M. Reid, Far East Director, American Soybean Association, 12-21 3 Chome Alasaka, Minato-Ku, Tokyo 107, Japan; or, PAC-ASIAN Services, Pte. Ltd., P.O. Box 496, Maxwell Road Post Office, Singapore 2, Singapore.

FAO Plant Production and Protection Paper No. 4, "Soybean Production in the Tropics" by K. Hinson and E. E. Hartwig, is now available. You may obtain a copy free of charge by writing to: Dr. H. A. Al-Jibouri, Senior Officer, Field Food Crops Group, Crop and Grassland Production Service, Plant Production and Protection Division, Food and Agriculture Organization, Via delle Terme di Caracalla, 00100 Rome, Italy.

FIRST CALL FOR 1978 SHORT COURSES

Next year for the fourth consecutive year INTSOY, in cooperation with the U.S. Department of Agriculture and USAID, will offer two training courses, "Soybean Processing for Food Uses" and "Technical and Economic Aspects of Soybean Production."

"Soybean Processing for Food Uses" will last about six weeks, from mid-March through the first week of May, including orientation and debriefing in Washington, D.C. The course focuses on the principles and methods of processing whole soybeans and soybean products for human food and ways to apply this knowledge to the nutrition development objectives of particular countries. Lectures, demonstrations, and laboratory exercises will be supplemented by field trips to soybean processing facilities. Applications will be accepted until January 15, 1978.

"Technical and Economic Aspects of Soybean Production," a sixteen-week course beginning in early May and continuing through mid-August, looks at the technical and economic principles and practices of soybean production; the research, educational, and regulatory functions supportive of a soybean industry; and the use of soybeans to alleviate protein-calorie deficiency problems in developing nations. March 1, 1978, is the deadline for applications.

INTSOY has no scholarships to offer, so participants must have their own financing. USAID has been the primary source of funding, but national organizations are now assuming a major funding role. If you are interested in participating or would like to sponsor a participant, you may get additional information from the INTSOY office or from Mr. Earl B. Terwilliger, ERS/FDD, International Programs Office, U.S. Department of Agriculture, Washington, D.C. 20250.

STAFF CHANGES

Two new staff members have joined INTSOY and a third has accepted a position. R. Stewart Smith, formerly with Agricultural Laboratories of Columbus, Ohio, has begun work at the University of Puerto Rico, Mayagüez Campus, where he will direct research in Rhizobium microbiology. James M. Spata, on leave from Ralston-Purina, St. Louis, has begun a two-year assignment in Kandy as Food Processing Specialist for the Sri Lanka Soybean Development Project. John W. Santas, who is currently Resident Coordinator for the Wisconsin-Purdue Agricultural Loan Project in Brasil, has accepted the new INTSOY position as International Training and Communications Specialist, effective January, 1978.

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NO. 13, DECEMBER, 1977

MAJOR CHANGE IN INTSOY SOYBEAN VARIETY DEVELOPMENT PROGRAM

Most scientists and administrators are familiar with the International Soybean Variety Experiment (ISVEX) trial, which contains 16 varieties of proven wide adaptability. Also, most know about the Soybean Preliminary Observation Trial (SPOT), initiated in 1976 for the purpose of evaluating promising new cultivars in the important environmental zones throughout the tropics and subtropics. INTSOY scientists have now established yet another soybean variety trial, designated SIEVE (Soybean International Experimental Variety Evaluation). This new trial adds the last link in the chain from breeder to farmer. Major benefits include an organized sampling and characterization of improved varieties from all of the world's germplasm and a more rapid dissemination of improved varieties to farmers.

The entries for SIEVE are to come from soybean breeders throughout the world, who are invited to contribute up to three cultivars. These new lines are then planted and characterized at tropical and subtropical locations. Improved cultivars will now progress from plant breeder to SIEVE to SPOT to ISVEX to farmer. A better-adapted variety can conceivably reach the farmer within four years instead of many years.

Because SIEVE is a new trial, it is important to understand how it operates and what it can do. The relationship of the plant breeding programs of an institution to SIEVE should be considered in the overall context of its national and international objectives.

Until now most varieties that INTSOY included in the ISVEX trial have come from commercial U.S. sources. A wide range of Maturity Groups from 00 to X has been included in trials conducted in many different countries from 1973 through 1977. Cooperators have found these varieties to be widely adapted and to yield well. However, ISVEX trial results have also indicated that better-adapted varieties are needed near the equator. Shattering, poor seed quality, and poor inoculation have been observed at several locations.

To develop better varieties and crop husbandry techniques, INTSOY established a research base at the University of Puerto Rico. Working cooperatively, scientists in plant breeding, microbiology, and plant protection have developed new improved cultivars.

Because cooperators included one or two local varieties in the ISVEX trials, it quickly became apparent that quite a few sources of improved varieties are available throughout the world. However, the quantity of seed for these varieties was limited. INTSOY has adopted several approaches to utilize these sources. For example, modified trials similar to ISVEX have been carried out in cooperation with other international research institutes. The objectives of these cooperative trials have been realized and therefore they were discontinued. Next, SPOT was organized and trials were conducted at six locations in both 1976 and 1977. The main advantage of SPOT is that new unproven varieties can be tested in a few representative ecological zones. A disadvantage is that most varieties have come from the Puerto Rican program because access to other breeding programs is limited and quantities of seed for even the few SPOT locations are insufficient. The SIEVE trial was organized to build on these experiences and relationships.

Relationship of SIEVE, SPOT, and ISVEX. The strategy for the genetic improvement of soybeans is founded upon evaluation of varieties under different environmental conditions, identification of characteristics limiting adaptation, introduction of desirable characteristics into existing cultivars, and establishment of communication among scientists in order to enhance the generation, evaluation, and use of improved cultivars.

The SIEVE method of operation is quite simple. Any plant breeder can contribute entries. Seed will be broken into three lots for planting at three different latitudes, namely, 0° (South America), 18° (Puerto Rico), and 30° (southern United States). We anticipate that up to 100 entries could be included. The varieties will be characterized and 20 to 30 varieties selected for the SPOT trial.

The SPOT trial will be planted the next year at 10 to 15 locations representing major ecological zones. Seed for SPOT will be saved from the SIEVE trials. From the SPOT trial results the best-adapted varieties will be chosen for the ISVEX trial, which will be conducted the following year.

As in the past, ISVEX will have 16 entries and

will emphasize tropical and subtropical regions. Cooperators are encouraged to save seed from the best-adapted varieties for their own use. We expect that 80 to 120 ISVEX trials will be distributed each year.

How SIEVE works. During September, 1977, letters explaining the purpose of SIEVE were sent to all known soybean breeders in tropical and subtropical programs. Because of the positive response, kits for submitting varieties were sent to breeders in December. Breeders have been asked to contribute at least 800 grams of seed for one to three cultivars, which should be new and improved crosses or selections that have progressed to at least the F_6 generation. The kits sent to breeders for seed samples contain plastic bags, desiccant, and boxes. Samples are to be mailed to the U.S. Department of Agriculture for clearing and forwarding to INTSOY.

The cultivars will be planted at three widely separated latitudes. Cultivars will be characterized for photoperiod response, days to flowering and to maturity, inoculating capacity, insect and disease resistance, and seed quality.

The cultivars selected from SIEVE for SPOT will possess a wider range of identified characteristics. One of the advantages of this system will be the elimination of source effect. Since the SPOT trial is planted at 12 to 15 locations, there will be a better estimate of yield stability and evaluation of specific characteristics. Cultivars can then be selected with more confidence for the ISVEX trial.

A major problem with ISVEX is how to obtain from one source 90 kilograms of high-quality seed which has 85-90% germination. To eliminate this problem, seed of all cultivars in SPOT will be increased concurrently at Puerto Rico in order to have adequate seed for those entries selected for inclusion in ISVEX.

If you know of a soybean breeder or agronomist who has an active crossing or selection program but who did not receive notice of the SIEVE trial, please notify INTSOY so that every scientist might have the opportunity to submit entries. Every phase of this genetic improvement system relies heavily upon the active cooperation of scientists around the world.

PLANS FOR 1978 ISVEX

Varieties selected for the 1978 ISVEX trials include tropical, subtropical, and temperate groups. The tropical trial contains seven new entries, which were identified through the Puerto Rican soybean breeding program, the 1976 and 1977 SPOT trials, and soybean breeders in other countries and organizations. The new SIEVE and SPOT system is expected to have a major effect on ISVEX by 1980.

SECOND WORLD SOYBEAN RESEARCH CONFERENCE

North Carolina State University in Raleigh, North Carolina, will host the Second World Soybean Research Conference in March, 1979. Make plans to attend; the next issue of the *Newsletter* will have more information.

NEW PUBLICATIONS

Numbers 12 and 13 in the INTSOY Publication Series are now available free of charge. Number 12 is *Rust of Soybeans — The Problem and Research: Report of a Workshop Held in Manila, Philippines,* by R. E. Ford and J. B. Sinclair, coeditors. Number 13 is *Pedigrees of Soybean Cultivars Released in the United States and Canada* by T. Hymowitz, C. A. Newell, and S. G. Carmer.

TWO PROJECTS COMPLETED

A four-man INTSOY team has completed a miniproject to assist the Faculty of Agriculture at the University of Panama. During October and November Guillermo Riveros (weed science), Michael Irwin (insect control), W. M. Sager (soybean production), and Pedro Melendez (disease control) each spent up to two weeks assisting in the development of research programs. The project was funded by the USAID Mission to Panama.

In late October a two-man INTSOY team arrived in Baghdad on a short mission to determine the potential for soybean production in Iraq. William H. Judy (agronomy) and John C. Siemens (agricultural engineering) returned to headquarters in mid-November to complete their report. The mission was arranged and supported by the Food and Agriculture Organization.

INTSOY is a program of the University of Illinois at Urbana-Champaign and the University of Puerto Rico, Mayagüez Campus, cooperating with international and national organizations to expand the use of soybeans for human food.

International Soybean Program
INTSOY NEWSLETTER
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
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CABLE: INTSOY, TELEPHONE (217) 333-6422

NO. 14, MAY, 1978

SRI LANKAN SOYBEAN DEVELOPMENT PROGRAM

Experiences of the Sri Lankan soybean development program illustrate the opportunities and problems associated with a broad-based national program of crop production, marketing, processing, and utilization. INTSOY has assisted with the research and educational component of this program in collaboration with the Government of Sri Lanka and several of its agricultural organizations. Support has been provided by the United Nations Development Program (UNDP), the Food and Agriculture Organization of the United Nations (FAO), the United Nations Children's Fund (UNICEF), and CARE.

Soybean production continues to improve in Sri Lanka, and the potential for a still greater increase is excellent. In 1977 about 400 hectares of soybeans were grown in the Yala season (April to September) and 2,000 hectares in the Maha season (September to February).

Yields of more than 4,000 kilograms per hectare are common in experimental field trials. At present farm yields average less than 1,100 kilograms per hectare, but some farmers have realized as much as 2,445 kilograms per hectare. With further research, extension, and experience farm yields will increase appreciably. Farmers are frequently unaware of their soil needs with respect to fertilizers and lime. Soil analysis laboratories are needed to provide the extension service with information for proper fertilizer recommendations.

Current production research includes work in breeding, agronomic practices, soil and water management, development of Rhizobium inoculum, and protection. Among the objectives of the breeding program are the improvement of seed quality and the development of high-yielding adapted varieties with resistance to important diseases and insect pests. Four activities are underway: (1) evaluation of germplasm from various sources; (2) evaluation of segregating breeding populations obtained from INTSOY's breeding program in Puerto Rico and from programs in India, Australia, Taiwan, Africa, and the United States; (3) hybridization of promising breeding lines followed by intensive selection; and (4) extensive variety testing, especially in the dry and intermediate zones.

Agronomic research has not kept pace with the breeding program and with variety evaluation. To determine the appropriate package of practices for each agro-ecological zone where soybeans are likely to be grown, additional research is needed on time of sowing, spacing, and plant population; plant nutrition and fertilizers; weed control, including evaluation of herbicides and nonchemical means of control; and seedbed preparation. The capability for Rhizobium inoculum production is being developed not only for soybeans, but for all food and forage legumes, and carrier materials are being assessed. An existing building is being altered for the research and pilot production facility.

To date, soybean diseases are not a limiting factor for production in Sri Lanka; however, there are several diseases, including two viral diseases, that pose a threat. Pathology research and personnel training need to be intensified. Insects, such as the hairy caterpillar, flea beetle, bean fly, stem fly, and stink bug, are present on soybeans, but thus far losses have been minimal. Collaboration between virologists and entomologists is needed in the study of yellow mosaic virus.

Because timeliness is the most important factor in carrying out field operations, the adoption of small-scale mechanization is being encouraged. The cost of equipment is a major obstacle, but there is need for a level of mechanization for harvesting to ensure good grain quality. Mechanical threshing is more economical than other methods now used in Sri Lanka. Two soybean thresher designs, the IRRI (International Rice Research Institute) design axial flow thresher and the German Standardwerke models, are being produced experimentally by Agro Technica in Sri Lanka. A major research and field evaluation program on animal-powered equipment for land shaping, seedbed preparation, planting, interrow cultivation, and harvesting needs to be initiated.

The economics of marketing and processing soybeans have been considered in detail. Cost of production studies continue; preliminary data indicate

that the average cost of production is about US$165, or Rs2,500, per hectare. Returns from soybeans and competing crops are being compared and various marketing systems investigated. An INTSOY agricultural economist has suggested a method for adjusting soybean prices for differences in quality and has recommended establishing a base price of 16 US cents, or Rs2.50, per pound.

CARE and UNICEF have provided a considerable impetus to the utilization of soybeans for food by allocating $454,000 for constructing and equipping a pilot food processing plant and training facility. Extensive renovation of two large buildings at the Central Agricultural Research Institute is nearing completion. These buildings will house research facilities for soybean processing and for the development of village-based utilization. To provide uncontaminated water for the pilot plant, a well 15 feet in diameter and 45 feet deep has been dug. A number of products will be developed at the plant, and then studies will be conducted to determine which products are acceptable to the population.

The development and dissemination of village-level technology is an important part of the soybean utilization program. In a separate complex now being constructed adjacent to the pilot plant, extension workers and farm women will be taught how to prepare traditional dishes from whole soybeans in the home. This complex, with five separate cooking units, will use only equipment that is available locally to housewives. Project personnel work closely with the Farm Women's Agricultural Extension Program of the Department of Agriculture.

At present the utilization of soybeans is a bottleneck in the attempt to develop a soybean industry with the proper balance between production, marketing, processing, and utilization. High priority is therefore given to completing the pilot plant and to developing soybean products.

Forty-two part- and full-time soybean workers constitute the Sri Lankan staff under the leadership of Mr. H. M. E. Herath. A soybean committee, chaired by the Director of Agriculture, provides policy guidance and program review. During the past year, four members of the Sri Lankan national staff received training at the University of Illinois, and the number of staff who have received training in India was increased to twenty-two.

Two INTSOY staff members are resident in Sri Lanka: Carl N. Hittle, Project Leader and Senior Agronomist, and James M. Spata, Food Processing Specialist. They have been supported by fifteen short-term consultants for varying periods.

A more detailed report of the Sri Lankan program may be obtained by writing to INTSOY.

PLANT BREEDING SYMPOSIUM II

Soybean breeders and associated scientists will want to consider participating in the second international Plant Breeding Symposium from March 12 through 16, 1979. The host sponsor will be Iowa State University, Ames, Iowa, USA. The Symposium will review plant breeding advances of the past 15 years and will evaluate areas of future development. During the ten half-day sessions the following topics will be considered: progress toward meeting human needs through plant breeding, exotic germplasm resources and utilization, application of tissue culture to plant improvement, morphological and physiological traits, selection and breeding methods, chromosomal and cytoplasmic manipulations, breeding for stress environments, pest resistance, development of plants for multiple-cropping systems, and improvement of nutritional quality.

For Symposium registration and program information write to Dr. K. J. Frey, Agronomy Department, Iowa State University, Ames, Iowa 50011, USA. Telephone: (515) 294-7607 or TWX 910-520-1152.

SECOND WORLD SOYBEAN RESEARCH CONFERENCE

This Conference will be held at Raleigh, North Carolina, USA, from March 26 through 29, 1979. North Carolina State University at Raleigh will be the host sponsor. Other sponsors include the North Carolina Soybean Producers Association, INTSOY, and the National Soybean Crop Improvement Council.

This Conference and the Plant Breeding Symposium have been scheduled so that soybean breeders may attend both meetings, with the intervening week available for visits at other points of professional interest. For additional information about the Conference contact Dr. B. E. Caldwell, Head, Department of Crop Science, School of Agriculture and Life Sciences, North Carolina State University at Raleigh, Raleigh, North Carolina 27607, USA. Telephone: (919) 737-2647.

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NO. 15, NOVEMBER, 1978

SOYBEAN DEVELOPMENT PROJECT IN PERU

A recently implemented project in Peru illustrates how INTSOY works with country research, educational organizations, and individuals to expand the use of soybeans as a nutritious food crop. The report that follows describes this project.

In early 1975 the U.S. Agency for International Development (USAID) asked INTSOY to assist the Government of Peru in analyzing the potential for soybean production and use in Peru and in developing a preliminary plan. During the next year and a half a number of INTSOY scientists and colleagues in the Ministry of Food developed recommendations for an expanded soybean production and utilization program. They concluded that soybeans, if included in rotation systems, had greater potential than other crops to produce financial returns to farmers. Compared with other possible investments, returns to the economy might be substantial. In addition, soybeans can provide nutritional benefits not now available to the poorest people.

In November, 1977, USAID and the University of Illinois signed a contract in which INTSOY was delegated to provide the technical assistance services required. The general objectives of the contract are to help the Government of Peru expand the cultivation of soybeans in high jungle areas and to increase consumption of improved soybeans and soybean products. Specific objectives include the following:

— To assist the Peruvian Ministry of Food to develop and adjust comprehensive action plans in soybean research, production, processing, and marketing in order to reach targeted production and consumption objectives.

— To provide technical information and to assist the Peruvian Ministry of Food in identifying soybean varieties through research, to develop agronomic practices that are transferable to small farms, and to identify soybean products and processes.

— To assist in making economic analyses to measure the impact of project activities in the project areas.

— To train people in Peru and to assist in selecting candidates for academic training abroad.

— To coordinate academic and short-term training in the United States and other locations.

— To assist in project evaluations in cooperation with the Peruvian Ministry of Food.

INTSOY began posting a well-qualified team of specialists in Peru in early 1978: Thomas M. Fullerton, soybean extension agronomist and INTSOY principal representative; Luis M. Camacho, soybean research agronomist; Alfred G. Harms, agricultural economist; and Alvin Siegel, soybean food processing specialist.

Dr. Camacho, working principally with research staff, has begun a program (1) to observe and characterize soybean germplasm to determine its potential use in the Peruvian research program, (2) to identify high-yielding varieties with desirable agronomic traits for commercial production in the Selva areas, and (3) to combine, through hybridization, desirable traits for transfer from one variety to another. Six hundred twenty breeding lines have been planted at the El Porvenir Research Station for the breeding program and yield trials. Forty-five varieties are being examined for resistance or tolerance to iron chlorosis, a problem in the Huallaga Valley. Plans are underway to plant soybeans in the Bagua-Jaen area, where the crop will rotate with rice under irrigated conditions.

Dr. Fullerton and his colleagues in production research and extension are disseminating production technology for soy culture in the High Selva. Working with counterpart staff, he is defining various constraints that prevent the introduction of soy into existing production systems or that limit profitable yield levels. He is helping to design methods for solving problems related to environmental and physical characteristics of production areas, the level of technology available to farmers, and their capacity to absorb new technology. He will also try to strengthen the support of producers through demonstrations, field days, and farmer short courses. He plans to develop materials for dissemination of agronomic practices for soy production, including slide series and printed information. Finally, he is working to involve staff from production agencies and research centers in agronomic or applied research projects conducted in the fields of cooperating farmers.

Dr. Siegel is working with staff of the Instituto Investigaciones Agro-Industriales (IIA) to develop three soy food products for the Peruvian diet: a soy beverage, a fortified bread product, and a soy-fortified pasta product. Other baked goods and foods fortified with soy derivatives will be investigated for

their potential use after preliminary information on the three prototype products has been evaluated. An acceptance-testing program, to include both rural and urban areas, will be established. Later, a program for demonstrating the preparation of soy food products will be started in rural and urban areas, with emphasis on rural areas. Nutrition education programs will be incorporated into the home demonstration program by engaging the support of the Institute of Nutrition and other government ministries. Contacts are being made with commercial food companies to determine their interest in commercial-scale production of primary soy food products.

Dr. Harms, working through the Production Zone Headquarters at Tarapoto, is conducting economic analyses of soybean production on small farms, machine use in soybean production, and soybean marketing. He will also investigate the credit needs of soybean producers and the competitive position of soybeans versus corn and other crops under government-administered prices. A pilot soybean thresher is being constructed near Tingo Maria. Cost studies of machine threshing versus hand threshing will be made to determine break-even points for purchase and use of mechanical threshers. In soybean marketing, Dr. Harms is collecting and analyzing transportation costs from production areas to oil mills and areas of consumption. He will determine the cost of transporting soybeans over the new road from Tarapoto to the coast. He will also update economic data relating to the construction of an expeller oil mill in Tarapoto.

This team, along with Illinois and Puerto Rico staff members, helped place four scientists in the master's degree program at the University of Puerto Rico, Mayagüez Campus. In summer 1979, these scientists will probably participate in the INTSOY-sponsored short course "Technical and Economic Aspects of Soybean Production" as part of their degree program. A fifth scientist spent four months in practical training at the University of Puerto Rico, Mayagüez Campus, before participating in the 1978 INTSOY production short course.

A more detailed report on the Peru program can be obtained from INTSOY.

OILSEED CROPS STUDY IN EGYPT

In mid-October INTSOY, with the support of USAID, began a two-month study of oilseed crops in Egypt at the invitation of the Egyptian Government. The objectives are to analyze the oilseed crops situation and to recommend ways to increase the production, marketing, and processing of oilseed crops and to up-date production methods. Team members are: Russell T. Odell, team leader and agronomist; Joseph A. Jackobs, soybean breeder; Ronald J. Henning, oilseeds agronomist; William H. Judy, soybean agronomist; Daniel I. Padberg, marketing economist; Earl R. Swanson, production economist; and Scott E. Cramer, oilseeds processing specialist.

SOYABEAN ABSTRACTS

Soybean research workers will be interested to know that the Commonwealth Agricultural Bureaux (CAB) has recently issued a new abstracting journal, "Soyabean Abstracts." This new journal brings together abstracts published in CAB's broader abstracting journals. "Soyabean Abstracts," published in collaboration with the International Food Information Service, also contains abstracts from "Food Science and Technology Abstracts." Coverage of the world research literature is emphasized. Subject areas include: breeding, agronomy, plant protection, physiology, storage, food science and technology, economics, and related subjects. "Soyabean Abstracts," issued monthly, is expected to have 1,600 citations annually.

Specimen copies and prices are available from: The Editorial Director, Commonwealth Agricultural Bureaux, Farnham Royal, Slough, SL2 3BN, England.

NEW PUBLICATIONS

Numbers 14 and 15 in the INTSOY Publication Series are now available. Write to INTSOY for single copies. Number 14 is "Whole Soybean Foods for Home and Village Use," assembled by A. I. Nelson, M. P. Steinberg, and L. S. Wei (1978, 31p.). Number 15 is "International Soybean Variety Experiment: Third Report of Results, 1975," by D. K. Whigham and W. H. Judy (1978, 369p.). The first and second reports of results are contained in Numbers 8 and 11 in the INTSOY Series, respectively. The fourth report of results for 1976 is in press and will soon be available as Number 16 in the INTSOY Publication Series.

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NO. 16, FEBRUARY, 1979

INTSOY EDUCATION AND TRAINING

INTSOY is unique among international agricultural research centers. Unlike other centers which have been established as new organizations with new physical facilities, INTSOY builds on the strengths of existing institutions around the world. The close alliance with the Universities of Illinois and Puerto Rico provides special advantages.

The use of soybeans to alleviate human nutritional deficiencies is our primary goal. To this end we have formed an international network of organizations, programs, and activities that explore all aspects of soybeans — production, harvesting, marketing, processing, and utilization. Organizations and individuals who share our concern are encouraged to take part in this network.

INTSOY works with institutions having well-established and fully-integrated programs in agricultural research, teaching, and extension. Through them we have access to a wide range of activities related to human resource development. These activities are crucial to all agricultural development endeavors.

Throughout the INTSOY experience, education and training have been at the core of the program. Only by directly involving others in learning about soybeans can we hope to achieve our goal. This issue of the Newsletter describes the varied educational opportunities coordinated by INTSOY.

Short courses. INTSOY's training effort features two short courses: Technical and Economic Aspects of Soybean Production, and Soybean Processing for Food Uses. These courses combine classroom instruction, laboratory work, field study, and travel.

The production short course coincides with the soybean growing season in the United States. Participants can thus observe all phases of production and confer with many soybean workers during this period of intense activity. The processing course teaches the principles and procedures for blending high protein and calorie soybeans with a wide variety of human foods. Processing methods suited to both village and industrial technology are emphasized.

Through these courses scientists, extension workers, and institutions from around the world can share their common interest in expanding the use of soybeans. Participants have the unique chance to work side by side with INTSOY staff for an extended time. They study the U.S. soybean industry and the public and private organizations that support it. Participants also see firsthand how research and the process of technology adaptation and transfer can reinforce each other.

The short courses are not funded through contracts or grants. Because the courses are self-supporting, all participants must be sponsored.

Degree-level programs. INTSOY serves as a clearinghouse for planning and administering degree-level study programs. Our staff can assist with all phases, including admissions, financial management, and administrative procedures during the program. Academically qualified students can be placed in suitable fields of study at educational institutions that will best serve individuals and their home countries.

Training outside the U.S. We are currently developing programs closer to those areas where needs and problems exist. We are particularly interested in countries that are in the early stages of starting a soybean industry. Cooperation between local institutions and INTSOY is the cornerstone of these training sessions. In-country sessions can be held as seminars, conferences, or workshops, and ideally should last from one to four weeks. Topics will be selected on the basis of local or regional needs.

INTSOY personnel have already participated in such workshops in Peru and Ecuador. And in India we worked with G. B. Pant University of Agriculture and Technology to set up a training program for staff involved in the Sri Lanka soybean development project.

We would like to receive reader's opinions about the need for in-country sessions and the way they should be conducted.

Visiting soybean workers. Visitors are welcome at INTSOY. We are eager to make their visits successful, and will, upon request, prepare individual programs for them. During 1978, 140 scientists and administrators from 20 countries visited the University of Illinois specifically to confer with INTSOY staff. Some of these visitors, as well as others, also visited the University of Puerto Rico, other universities, and U.S. Department of Agriculture personnel. With

information provided well in advance, we can schedule appointments so that time can be used efficiently.

Visitors usually spend a day or two consulting with selected staff members on topics of mutual interest. But scientists can also make long-term arrangements for research, study, and consultation at INTSOY headquarters, in Puerto Rico, or with other institutions within the network. In general, all short- and long-term visitors who have sponsorship are expected to share the cost of this training.

Conferences. Short courses and degree programs provide formal training. Regional conferences, on the other hand, bring soybean workers together for less formal training and exchange of information. Conferences have been held for Latin America and the Caribbean; Africa, the Middle East, and South Asia; and for Asia and Oceania. Proceedings of these conferences appear in INTSOY Series Numbers 2, 6, and 10.

Workshops. The Workshop on Soybean Rust, which convened in Manila, the Philippines, was the first regional meeting to deal with a specific problem. The workshop was cosponsored by the Asian Vegetable Research and Development Center, the Philippine Council for Agriculture and Resources Research, and INTSOY. Proceedings appear in Number 12 of the INTSOY Series.

Another regional, problem-specific meeting, Irrigated Soybean Production in Arid and Semi-Arid Regions, is planned for September, 1979. For more information see the separate announcement in this issue of the Newsletter.

1979 SHORT COURSES

Instruction for Technical and Economic Aspects of Soybean Production will begin May 14 and end August 17. Course instruction is multidisciplinary and uses a problem-solving approach to familiarize students with the soybean industry and problems encountered in soybean production.

Soybean Processing for Food Uses will begin June 18 and end July 27. Individuals working in food science and technology, nutrition, and home economics will want to consider attending. This course will cover the rapidly increasing array of soybean food products and the processing methods involved.

Estimated cost for each participant is $3,850 for the processing course, and $6,600 for the production course. These sums include living expenses, training fees, materials, books, and field-trip transportation. International transportation to and from the University of Illinois is *not* included. Additional information is available from John W. Santas, INTSOY.

IRRIGATED SOYBEAN CONFERENCE

INTSOY is the lead organization in planning a Conference on Irrigated Soybean Production in Arid and Semi-Arid Regions. The conference will be held in mid-September, 1979, in Cairo, Egypt. The objectives are to review the latest research results on production of soybeans under furrow and flood irrigation, to identify problems, and to propose needed research. Most of the delegates will be from North African, Middle Eastern, and Mediterranean countries. The conference, which will be held in English, is sponsored by the Egyptian Ministry of Agriculture, Menoufia University, Egypt, and INTSOY in collaboration with FAO/Rome, and USAID, Egypt. For more information contact W. H. Judy, INTSOY, or any sponsoring organization.

SOYBEAN BREEDER CHOSEN

Dr. Quyen H. Nguyen has been appointed Assistant Professor, Department of Agronomy, University of Illinois. Dr. Nguyen is stationed at the University of Puerto Rico, Mayagüez Campus, where he is responsible for the INTSOY soybean breeding program. He succeeds E. Hamer Paschal II.

NEW PUBLICATIONS

Number 16 in the INTSOY Publication Series is now available and Number 17 will be ready by April 1. Number 16 is "International Soybean Variety Experiment, Fourth Report of Results, 1976," by W. H. Judy and D. K. Whigham. Number 17 is "The Literature of Arthropods Associated With Soybean. V. A Bibliograpy of *Heliothis zea* (Boddie) and *H. virescens* (F.) (Lepidoptera:Noctuidae)," by J. Kogan, D. K. Sell, R. E. Stinner, J. R. Bradley, Jr., and M. Kogan. The Illinois Natural History Survey, and North Carolina State University, cooperated on Number 17.

INTSOY MAILING LIST

We are still updating the mailing list. If you have not yet sent us your current mailing address, please do so.

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NO. 17, MAY, 1979

THE INTSOY PROFESSIONAL STAFF

INTSOY's Soybean Insect Research Information Center (SIRIC) recently received from Honduras a letter expressing thanks "for the very helpful literature that you sent my way. I had no idea that there was such an organized soybean program." The writer asked that we send her a list of INTSOY personnel and their projects.

This request was a reminder that a list of current INTSOY staff has not been published in the Newsletter since August, 1976. In this issue we will introduce readers to the staff at base and outreach locations and briefly describe their work. You are encouraged to contact them directly about matters of mutual interest.

Base staff are located at the University of Puerto Rico, Mayagüez Campus, and the University of Illinois, Urbana-Champaign Campus. Outreach teams are located in Peru and Sri Lanka.

1. University of Puerto Rico, Mayagüez Campus
College Station
Mayagüez, Puerto Rico 00708

Administration

Raul Abrams, Associate Director of INTSOY and Director of the Agricultural Experiment Station, University of Puerto Rico.

Production

Quyen H. Nguyen, assistant professor of agronomy. Breeding soybeans for high yield, seed quality, agronomic types, and insect and disease resistance by using exotic germplasm and hybridization with wild species of *Glycine*.

R. Stewart Smith, assistant professor of agronomy. Soil microbiologist investigating *Rhizobium japonicum* inoculation in the tropics, inoculant production, carriers, methods of use, and factors affecting *Rhizobium*.

James Oard, assistant agronomist. Breeding, nursery management, design of field trials, and maintenance of working germplasm collection and seed stocks of breeding lines.

Protection

Nelia Acosta, assistant professor of nematology. Chemical control and screening for resistance to nematode pests of soybeans.

Paul Hepperly, assistant professor of plant pathology. Relationships of diseases occurring on wild or cultivated legumes to soybean production.

Pedro Melendez, professor of plant pathology. Chemical control and screening for resistance to foliar pathogens of soybeans.

Guillermo Riveros, associate professor of plant physiology and weed science. Weed control through chemical and cultural practices.

2. University of Illinois at Urbana-Champaign
113 Mumford Hall
Urbana, Illinois 61801

Administration

William N. Thompson, Director of INTSOY. Farm management and agricultural policy; institutional organization, development, and evaluation; agricultural technology in development.

Thomas A. McCowen, Assistant Director of INTSOY. Development economics; project identification, development, management, and evaluation. Peru outreach program coordinator.

Production

Joseph A. Jackobs, professor of agronomy. Multiple cropping, cropping systems, and seed quality. Sri Lanka outreach program coordinator.

William H. Judy, associate professor of agronomy. Soybean variety evaluation program, development of soybean production programs, and research on effect of soil factors on germination and growth.

John C. Siemens, professor of agricultural engineering. Machinery selection, and tillage and planting systems for corn and soybeans.

Henry J. Hill, assistant agronomist. International variety testing and evaluation; soybean seed germination and emergence.

Protection

Robert M. Goodman, associate professor of plant pathology. Soybean diseases caused by viruses, seed and insect transmission of plant viruses, soybean virus epidemiology, and breeding for resistance to viruses.

Michael E. Irwin, assistant professor of agricultural entomology. Insect pest management, biological control of soybean insect pests, virus-vector interactions, and virus epidemiology.

Marcos Kogan, professor of agricultural entomology. Soybean pest problems, integrated pest management systems, feeding and nutrition of pests associated with soybeans, and resistance in soybeans to insect pests.

James B. Sinclair, professor of plant pathology. Pathology and control of seed-borne fungal and bacterial pathogens in soybeans.

Teresa L. Shock, assistant plant pathologist. Viral diseases of soybeans, and aphid and seed transmission of diseases.

Utilization and Economics

Earl D. Kellogg, associate professor of agricultural economics. Social science research on development and adoption of cropping systems technology and on consequences of agricultural policy in developing countries.

L. S. Wei, professor of food science. Utilization of soybeans as food, weather damage to soybeans, raw material handling, and soy food processing.

Sheldon W. Williams, professor of agricultural economics. Economic aspects of soybean marketing and production in developing countries.

Information and Training

John K. Bouseman, assistant entomologist, Illinois Natural History Survey. Curator of IRCSA (International Reference Collection of Soybean-Associated Arthropods). Bionomics and identification of soybean-associated insects of the world.

Jenny Kogan, bibliographer, agricultural entomology. Librarian of SIRIC (Soybean Insect Research Information Center). Literature of soybean-related arthropods, bibliographic data base operations, and information storage and retrieval systems.

John W. Santas, assistant professor of agricultural communications. Development education, training, and communications specialist. Management and coordination of INTSOY's training programs for individuals and groups, and programming international visitors.

3. Peru
Av. Salaverry 674
Of. 802–8° Piso
Lima 11, Peru

Production

Luis H. Camacho, associate professor of agronomy. Breeding of improved soybean cultivars, and development of improved production methods to increase yield and quality of soybeans.

Thomas M. Fullerton, associate professor of agronomy. Technology transfer, crop ecology, soybean production, weed control, and soil and water management.

Utilization and Economics

Alfred G. Harms, associate professor of agricultural economics. Comparative costs of soybeans and related crops, cropping systems, and farm management.

Alvin Siegel, assistant professor of food science. Development of soy-based foods at commercial, intermediate, and low level technologies; nutritional evaluations of soy-based foods and beverages; nutrition project identification and management.

4. Sri Lanka
Central Agricultural Research Institute
Gannoruwa, Peradeniya
Sri Lanka

Production

Carl N. Hittle, professor of agronomy. Soybean breeding and production, agronomic research and technology transfer in tropical crops, and project identification and management.

Utilization

James M. Spata, assistant professor of food science. Soybean food and beverage product development, and technology transfer of soybean food processes requiring high, intermediate, and low levels of technology. (He will return to the Ralston Purina Co. in the United States in July.)

Others who have contributed to the INTSOY program include associated scientists at the Universities of Puerto Rico and Illinois, other U.S. universities, the federal government, and the private sector.

WORLD SOYBEAN RESEARCH CONFERENCE II

The WSRC II, held recently in Raleigh, North Carolina, USA, attracted 605 registrants from 40 countries and 35 U.S. states, according to H. Douglass Gross, Program Chairman. Professor Gross anticipates that the Proceedings will be available in October, 1979. People who were not registered for the conference can order the Proceedings from the publisher: Westview Press, 5500 Central Avenue, Boulder, Colorado 80301, USA. Estimated price is $35.

IADS–INTSOY AGREEMENT

The International Agricultural Development Service (IADS) and INTSOY, through the University of Illinois, have signed a memorandum of understanding. Under this agreement INTSOY will work with national institutions to improve research organizations, develop plans and projects, train personnel, and organize conferences and workshops.

The purpose of IADS, which was established in 1975, is to provide services to developing countries that want to strengthen their agricultural research and development programs. IADS is a private, nonprofit, scientific and professional agricultural assistance organization with personnel in Asia, Africa, and Latin America. The address of IADS headquarters is: 1133 Avenue of the Americas, New York, New York 10036, USA. Cable: IADSERVIS, New York.

INTSOY is a program of the University of Illinois at Urbana-Champaign and the University of Puerto Rico, Mayagüez Campus, cooperating with international and national organizations to expand the use of soybeans for human food.

International Soybean Program
INTSOY NEWSLETTER
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
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CABLE: INTSOY, TELEPHONE (217) 333-6422

NO. 18, AUGUST, 1979

COMPUTERIZED SYSTEMS FOR INSECT RESEARCH

Disseminating information about soybean insects is a major part of INTSOY's entomology outreach program. To aid research on soybean insects, two computerized systems were developed: the Soybean Insect Research Information Center (SIRIC), and the International Reference Collection of Soybean-Associated Arthropods (IRCSA). Established in 1969, these systems are joint projects of the Illinois Natural History Survey and INTSOY.

SIRIC. The four principal objectives of the SIRIC system are:

— To survey the world literature on soybean-related arthropods and to establish a data base for that literature.
— To collect and organize relevant documents such as journal articles, book chapters, and reports and to develop a retrieval capability through the use of code descriptors.
— To aid researchers, extension workers, students, and others by conducting computer searches and by providing copies of documents in the collection.
— To compile and publish bibliographies on key soybean pests.

The literature collection contains more than 17,000 documents. Two types of documents are selected for inclusion: those dealing with arthropod pests specifically on soybeans, and those dealing with 24 important species regardless of plant association. SIRIC therefore contains many documents pertaining to crops often grown in association with soybeans.

Bibliographic references and key words describing the subject content of documents are stored for retrieval in a computerized file that uses the University of Illinois Cyber 175 computer. Computer searches of the file are tailored to match the information needs of users with the content of documents. The result is a printout of bibliographic citations in alphabetical order.

Bibliographies of the literature on important soybean insect species are published in the series *The Literature of Arthropods Associated with Soybean.* To date there are five bibliographies on the following insects: (1) the Mexican bean beetle, *Epilachna varivestis* Mulsant; (2) the southern green stink bug, *Nezara viridula* (Linnaeus); (3) the bean leaf beetles, *Cerotoma trifurcata* (Foster) and *C. ruficornis* (Olivier); (4) the velvetbean caterpillar, *Anticarsia gemmatalis* Hübner; and (5) the corn earworm and the tobacco budworm, *Heliothis zea* (Boddie) and *H. virescens* (F.).

The services of SIRIC are provided without charge to interested persons working with soybean insects. Soybean workers have been served in 46 countries.

IRCSA. The purpose of the International Reference Collection of Soybean-Associated Arthropods is fourfold:

— To survey the soybean-associated arthropods of all soybean-producing areas of the world, with special emphasis on the phytophagous species, vectors of soybean diseases, and the parasites and predators of those groups.
— To monitor the major pest species for possible changes in their geographic distribution.
— To aid in predicting insect problems in areas where soybean production is being initiated.
— To provide identification services for soybean researchers, extension workers, and producers.

Material in the collection has come from the travels of Illinois researchers, overseas collaborators, and exchanges with museum personnel. Some 150,000 identified specimens in about 2,500 species of soybean-associated insects and arthropods have already been accessioned. Curated in conventional fashion, the material is maintained in about 300 U.S. National Museum drawers and in 3,000 3-dram vials.

With the exception of Chile, coverage of the New World is essentially complete. Collections were initially from the United States, but about five years ago an intensive effort to survey Latin America was begun. Knowledge of the soybean-associated arthropods of Mexico, Brazil, and Colombia is such that we will soon be able to prepare comprehensive regional treatments of those areas. Although material from the Old World has been accessioned whenever opportunity allowed, we are now increasing efforts in that area.

A unique aspect of the collection is the attempt to have a research specialist determine the species of every specimen. A network of about 130 collaborat-

ing systematists in foreign and domestic academic institutions and museums has been created, and there are standing agreements to ship material to them as it accumulates. The valid scientific name of an organism, an indispensable key to the literature of that species, is necessary in the communication of scientific work.

Another unique aspect of the collection is that it is fully computerized. Each specimen bears a lot number that ties it to the detailed circumstances of its collection. Stored on magnetic computer tapes, the data from these samples can be retrieved in two ways: by requesting all species collected under a specified set of conditions such as location, date, or sampling method; or by requesting a listing of specific conditions under which a certain species has been sampled, for example, all locations where the southern green stink bug has been found. In this way IRCSA is providing basic biological information on the bionomics of soybean-associated arthropods.

Jenny Kogan gives leadership to the activities of SIRIC, and John K. Bouseman is curator of IRCSA. Michael E. Irwin is INTSOY entomologist. Marcos Kogan, Illinois Natural History Survey and University of Illinois entomologist, provides strong support to the INTSOY insect pest management program. For further information contact these staff members at 172 Natural Resources Building, Urbana, Illinois 61801, USA.

STAFF CHANGE IN SRI LANKA PROJECT

Dr. M. S. Chan joined the Sri Lanka Soybean Development Project in July as Food Processing Adviser. He replaced Dr. James Spata, who was with the project during a two-year leave from the Ralston Purina Company. Dr. Chan was with Kraft, Inc., for many years and most recently was a consultant for Archer Daniels Midland in Decatur, Illinois. The Sri Lanka project is supported by the United Nations Development Program through the Food and Agriculture Organization. CARE and UNICEF provide special support for food utilization activities.

REGIONAL CONFERENCES

INTSOY has initiated plans for three regional conferences on soybean seed quality and stand establishment, to be held in Asia, Africa, and Latin America in late 1980 and 1981. J. A. Jackobs, agronomist, and J. B. Sinclair, plant pathologist, will co-chair the planning committee. Those interested in participating in these conferences should contact INTSOY. Additional information will be reported in the INTSOY Newsletter.

SOYBEAN SHORT COURSES COMPLETED

Eleven participants in the Soybean Processing for Food Uses course received certificates from W. N. Thompson, INTSOY Director, on July 28: Patrice Coovi Gnacadja, Benin; Aldo A. Milanese, Chile; Pablo Guarderas, Ecuador; Mideksa Guttu, Ethiopia; Wilner Dessources, Haiti; S. H. Pherwani, India; Nancy Fuentes de Jimenez, Peru; Trinidad C. Gonzales, Philippines; V. Sangerappillay and H. W. S. Samarawickrama, Sri Lanka; and Hua-Yang Lee, Taiwan.

Certificates were presented on August 14 to the nine participants in the Technical and Economic Aspects of Soybean Production course: Onesimus B. Mmolawa, Botswana; Ahmad Mokhtar Khattab, Egypt; Suprapto Sumadi, Indonesia; Khan Badshah, Pakistan; Ricardo Villamonte, Peru; Hamad Mohamad Al-Hamran, Saudi Arabia; S. R. M. P. Jayawardhana, Sri Lanka; Adel R. Ali, Syria; and Noah F. Sichone, Zambia.

This year was the fifth time that these INTSOY-sponsored short courses were offered. L. S. Wei, Department of Food Science of the University of Illinois, was technical leader for the soybean processing course, and John W. Santas, INTSOY, was leader of the soybean production course.

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NO. 19, NOVEMBER, 1979

IRRIGATED SOYBEAN PRODUCTION CONFERENCE

Forty scientists attended a conference entitled Irrigated Soybean Production in Arid and Semi-Arid Regions, held in Cairo, Egypt, from August 31 to September 6. Participating countries were Australia, Bangladesh, Brazil, Colombia, Egypt, Ethiopia, Sri Lanka, Turkey, and the United States. The conference was sponsored by the Egyptian Ministry of Agriculture, Menoufeia University, and INTSOY in collaboration with the Food and Agriculture Organization of the United Nations and the U.S. Agency for International Development.

The program consisted of invited discussion papers, country reports, contributed papers, and sessions to identify constraints and problems in soybean production under irrigation. Menoufeia University organized a one-day field trip to intensified cropping areas north of Cairo and to the University research farm.

Subject matter covered all aspects of growing irrigated soybeans, including methods for introducing and promoting soybeans as a crop; variety development; seed production; land preparation and planting; protection against weeds, diseases, and insects; selection of machinery for various levels of mechanization; crop management; water use requirements of soybeans; and economics of production.

Dr. Paulden Knowles, the keynote speaker, stressed the importance of considering the broad picture, not just production, when introducing soybeans as a crop into a country. He identified the many biological, marketing, and development factors essential for a successful soybean industry. In the past, several elements have limited the success in proposed production areas. The marketing components of price, purchasing, and storage have not been adequately established. Research organizations have not developed adapted cultivars, suitable production practices, pest control strategies, and satisfactory inoculation techniques. Finally, the key component of farmer advisory services has not been included. If any part of this development chain is omitted, it is difficult to realize a steady expansion of area devoted to soybeans.

The conference participants attended work sessions during which they identified major constraints and problems affecting the economical production of soybeans under flood and furrow irrigation. Although the sessions were divided into production, irrigation, and plant protection sections, many problems were common to more than one category. The groups also attempted to establish priorities for research and extension activities. We hope these suggestions will be used as a basis for programs funded by national and international organizations.

At this conference, information on crop management of soybeans under flood and furrow irrigation was brought together for the first time. Participants were enthusiastic about the large amount of information presented and were anxious to share it with fellow scientists at home. Participants expressed the need to maintain better communication for the exchange of information. Most participants left the conference convinced that soybeans can be produced economically using irrigation and that soybeans have an important place in the food system of their countries.

The proceedings will be published early next year as part of the INTSOY Publications Series. The information in the proceedings should serve as a guide for planning soybean research according to the constraints and priorities identified by the participants. Much of the information may also be useful in irrigated production of legume row crops similar to soybeans. We will announce the publication date of the proceedings in a future Newsletter.

INTSOY PUBLICATIONS SERIES

At present INTSOY has seventeen titles in its Publications Series. Single copies can be obtained upon request, and the entire series is available to agricultural libraries.

No. 1 — Selected Literature of Soybean Entomology. G. L. Godfrey, editor. 1974, reprinted 1977.

No. 2 — Proceedings of the Workshop on Soybeans for Tropical and Subtropical Conditions. 1974, reprinted 1978.

No. 3 — A Case Study of Expeller Production of Soybean Flour in India. S. W. Williams and R. L. Rathod. 1974.

No. 4 — Soybean Processing in India: A Location Study on an Industry to Come. M. K. von Oppen. 1974.

No. 5 — Potential Production of Soybeans in North Central India. S. W. Williams, W. E. Hendrix, and M. K. von Oppen. 1974.

No. 6 — Soybean Production, Protection, and Utilization. Proceedings of a Conference for Scientists of Africa, the Middle East, and South Asia. D. K. Whigham, editor. 1975.

No. 7 — An Annotated Bibliography of Soybean Diseases. J. B. Sinclair and O. D. Dhingra. 1975.

No. 8 — International Soybean Variety Experiment. First Report of Results. D. K. Whigham. 1975.

No. 9 — Soybean Cultivars Released in the United States and Canada: Morphological Descriptions and Responses to Selected Foliar, Stem and Root Diseases. T. Hymowitz, S. G. Carmer, and C. A. Newell. 1976.

No. 10 — Expanding the Use of Soybeans. Proceedings of a Conference for Asia and Oceania. R. M. Goodman, editor. 1976.

No. 11 — International Soybean Variety Experiment. Second Report of Results. D. K. Whigham. 1976.

No. 12 — Rust of Soybeans: The Problem and Research Needs. Report of a Workshop in Manila, Philippines. R. E. Ford and J. B. Sinclair, co-editors. 1977.

No. 13 — Pedigrees of Soybean Cultivars Released in the United States and Canada. T. Hymowitz, C. A. Newell, and S. G. Carmer. 1977.

No. 14 — Whole Soybean Foods for Home and Village Use. A. I. Nelson, M. P. Steinberg, and L. S. Wei. 1978.

No. 15 — International Soybean Variety Experiment. Third Report of Results, 1975. D. K. Whigham and W. H. Judy. 1978.

No. 16 — International Soybean Variety Experiment, Fourth Report of Results, 1976. W. H. Judy and D. K. Whigham. 1978.

No. 17 — The Literature of Arthropods Associated With Soybean. V. A Bibliography of *Heliothis zea* (Boddie) and *H. virescens* (F.) (Lepidoptera: Noctuidae). J. Kogan, D. K. Sell, R. E. Stinner, Jr., and M. Kogan. 1978.

SOYBEAN PRODUCTION COURSE

Seventeen Peruvian and five Colombian production agents will participate in a three-week soybean production course to be held at Palmira, Colombia, beginning November 25. Sponsored by the Government of Peru soybean development project in conjunction with the Instituto Colombiano Agropecuario (ICA), the course is supported by the U.S. Agency for International Development. INTSOY staff stationed in Peru and Puerto Rico will share instruction responsibilities with ICA staff.

WORLD SOYBEAN RESEARCH CONFERENCE II PROCEEDINGS

Westview Press now anticipates that the Proceedings of the World Soybean Research Conference II will be available in February, 1980. The Proceedings may be ordered from the publisher: Westview Press, 5500 Central Avenue, Boulder, Colorado 80301, USA. Estimated price is US$35. A copy will be sent without charge to each conference registrant.

INTSOY NEWSLETTER IN SPANISH OR FRENCH

Beginning in February, 1980, INTSOY will publish Spanish and French editions of the quarterly Newsletter as well as the English edition. If you prefer the Spanish or French, be sure to let us know. When stating your preference, please include your current mailing address.

A partir de febrero de 1980, INTSOY ofrererá una edición en español de su publicación trimestral, INTSOY Newsletter. Si desea subscribirse, favor de remitir su nombre y dirección actual.

A partir de février de 1980, INTSOY offrirá une édition en français de sa publication trimestrielle, INTSOY Newsletter. Ceux qui voudraient souscrire devraient remettre leur nom et leur adresse actuelle.

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NO. 20, FEBRUARY 1980

INTSOY RESEARCH HIGHLIGHTS:
SOYBEAN GENETIC IMPROVEMENT PROGRAM

The purpose of this program is to identify and develop high yielding, nutritious soybean varieties suitable for production in tropical and subtropical areas. INTSOY's breeding program is centered in Puerto Rico, where soybean accessions and varieties developed by cooperating breeders are grown to identify desirable traits. These traits are then introduced into existing varieties. Crosses are made to produce segregating populations from which superior lines can be selected. Characters being studied include photoperiod insensitivity, resistance to diseases and insects, inheritance of hard seed coat, and retention of seed quality under tropical conditions.

A series of trials was developed to identify and evaluate the most promising varieties from many worldwide sources. These trials include SIEVE, Soybean International Experiment Variety Evaluation; SPOT, Soybean Preliminary Observation Trial; and ISVEX, International Soybean Variety Evaluation Experiment. INTSOY supplies the seed, inoculant, data collection sheets, and agronomic instructions for the trials. The cooperator provides the land, fertilizer, and management. During the experiments, the cooperator collects data on yield and on agronomic characters.

Additional information about the site and environmental conditions is also reported. Seed samples of each variety are returned to INTSOY for protein and oil analyses. Trial results are then analyzed and interpreted to determine the effect of latitude and altitude on individual varieties and on maturity groups and plant types.

The SIEVE experiments tap the many sources of improved soybean varieties from around the world. Plant breeders are invited to contribute their best improved varieties developed to generation F_6 or later. These cultivars are then planted at different latitudes in Ecuador, Puerto Rico, and the United States. The trials are monitored by cooperators and by INTSOY staff. After the seeds of varieties selected from SIEVE are multiplied in Puerto Rico, they are entered into SPOT. SIEVE thus serves as the first link in the variety evaluation and introduction chain leading from plant breeder to farmer.

The next link is SPOT, which provides further evaluation of germplasm in many types of environments. Currently 15 to 25 varieties are evaluated annually by cooperators in 18 major tropical zones. Some of the varieties tested in SPOT are selected for entry in ISVEX, the last in the series of international trials.

Only 16 soybean varieties of proven adaptability can be included in ISVEX each year. However, cooperators may substitute one or two local varieties for comparison. Cooperators are encouraged to select the ISVEX varieties best adapted to local conditions for further evaluation in crop husbandry experiments and, after seed increases, for direct introduction to farmers.

ISVEX has involved cooperators in 112 countries during its seven years of operation. Sixty-five varieties have been introduced and evaluated in environmental zones ranging from below sea level to above 1,800 meters, and from 40°N to 40°S latitude. An additional 88 varieties and accessions have been evaluated through SIEVE and SPOT.

The results from six years of variety evaluation have demonstrated that cultivars developed in temperate zones can provide large yields under experimental conditions in the tropics and subtropics. Existing germplasm was found to be more flexible and widely adapted than expected. Experimental yields have averaged between 2,200 and 3,000 kg/ha, and at selected locations have ranged from 4,000 to 6,000 kg/ha. The protein content of soybeans grown in the tropics has been comparable to that of soybeans grown in temperate zones.

The yield potential of cultivars grown in the tropics is not always related to the maturity group. For example, Davis in group IV has consistently yielded more than later maturing varieties at almost all latitudes and altitudes. Williams in group III has produced larger yields than some later maturing types, even though it flowered earlier and did not grow as tall. However, as a group, later maturing cultivars yielded more than earlier maturing cultivars.

Varieties flowered earlier and did not grow as tall under the shorter daylength condition nearer the equator and under the lower nighttime tempera-

tures at higher altitudes. Plant growth seems to be affected more by changes in altitude than by variable daylength. Number of days from flowering to maturity was remarkably similar among varieties regardless of the amount of time from planting to flowering.

Most U.S. cultivars performed well when grown in tropical environments and produced high quality seed. Plant lodging and seed shattering were not serious problems. Agronomic characters to prevent lodging and shattering are very desirable and can be incorporated into accessions having greater local adaptability to daylength and ambient temperature conditions.

Among all of the varieties evaluated, there was no significant relationship between seed size and yield. However, within a single variety, the larger the seed the greater the yield.

Analysis of the sources of variance in ISVEX results indicates that yields from the same soybean variety may be affected more by management techniques than by environmental conditions. Crop management skills are clearly an important part of successful soybean cultivation.

As a result of having conducted ISVEX trials, many countries have found that soybeans can be grown successfully and economically. Egypt selected three varieties for commercial production after several seasons of evaluating varieties primarily through ISVEX trials. Several hundred metric tons of Calland, Clark 63, and Harosoy were imported for the 1977 crop year, and 2,000 tons were imported for the 1978 season. This seed provided the base for successful, rapid expansion of commercial hectarage. Egypt increased yield per hectare, doubled the area under production every year from 1974 through 1978, and established a seed multiplication program within the country. Commercial production has now exceeded 40,000 hectares.

Iran, the Ivory Coast, Pakistan, the Philippines, and Syria have imported large quantities of seed for soybean production; Benin, India, Kenya, Morocco, Somalia, and the Sudan have purchased smaller quantities. Importation of seed has encouraged national grain legume production programs for seed while permitting the development of research, extension, and seed multiplication activities for a viable and consistent country program.

Through INTSOY's soybean evaluation program the response of varieties to many specific environments has been studied. Many countries with a potential for growing soybeans for food have begun production. INTSOY continues to provide support through the development and introduction of improved varieties with wide adaptation and resistances to insects, diseases, and nematodes. Variety development and evaluation must be uninterrupted because of dynamic biological systems and varied cropping patterns.

ABRAMS RETIREMENT

Raul Abrams retired from his positions as Associate Director of INTSOY and Director of the Puerto Rico Agricultural Experiment Station on January 31, 1980. Associated with INTSOY since its inception, Dr. Abrams was instrumental in the success of INTSOY's interinstitutional cooperative soybean program.

STAFF CHANGE IN PUERTO RICO

W. C. Stearn will succeed R. Stewart Smith as the INTSOY soil microbiologist in Puerto Rico. Dr. Stearn, who holds a Ph.D. from Ohio State University, begins in mid-February. Dr. Smith is now Director of Research and Development with Nitragin Co., Milwaukee, Wisconsin, USA.

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NO. 20, FEBRERO 1980

PUNTOS DESTACADOS EN LAS INVESTIGACIONES DE INTSOY
PROGRAMA DE MEJORAMIENTO GENETICO DE LA SOYA

El propósito de este programa es de identificar y desarrollar variedades de soya de alto rendimiento y de gran valor nutritivo, adecuadas para la producción en zonas tropicales y subtropicales. El programa de producción de INTSOY está situado en Puerto Rico, en donde cooperadores asociados cultivan accesiones y variedades de soya para identificar características deseables. Estas características son entonces introducidas a las variedades ya existentes. Se realizan cruces para producir poblaciones segregativas de las cuales se pueden seleccionar líneas superiores. Entre las características que se estudian se encuentran la insensibilidad a períodos de luz, la resistencia a enfermedades e insectos, la herencia de cutícula firme y la retención de cualidades de semilla bajo condiciones tropicales.

Se llevó a cabo una serie de pruebas para identificar y evaluar las variedades más prometedoras, provenientes de todas partes del mundo. Estas pruebas comprenden SIEVE (Soybean International Experiment Variety Evaluation), SPOT (Soybean Preliminary Observation Trial) e ISVEX (International Soybean Variety Evaluation Experiments). INTSOY suministra las semillas, inoculantes, formularios de colección de datos e instrucciones agronómicas para las pruebas. El cooperador suministra la tierra, los fertilizantes y el manejo, y reúne datos respecto al rendimiento y a las características agronómicas.

Información adicional en cuanto al sitio y las condiciones ambientales también se registra. Muestras de semillas de cada variedad son devueltas a INTSOY para análisis de proteína y aceite. Los resultados de las pruebas son entonces analizados e interpretados para determinar los efectos de la altitud y la latitud sobre variedades individuales y sobre grupos en distintas etapas de maduración y tipos de plantas.

Los experimentos de SIEVE aprovechan las muchas fuentes de variedades mejoradas de soya de todas partes del mundo. A los productores de semilla se les solicita contribuir las variedades superiores que han desarrollado hasta la generación F_6 o más. Estas cepas son sembradas en distintas latitudes en Ecuador, Puerto Rico y Estados Unidos. Las pruebas son vigiladas por los cooperadores y personal de INTSOY. Después que las semillas de variedades seleccionadas por SIEVE han sido multiplicadas en Puerto Rico, pasan a SPOT, donde se realizan pruebas preliminares. Así SIEVE sirve de eslabón inicial en la cadena de evaluación y presentación de la semilla que va del productor al agricultor.

El próximo eslabón lo constituye SPOT, el cual realiza evaluación adicional de germoplasma en diferentes tipos de ambientes. Actualmente, de 15 a 25 variedades son evaluadas anualmente por los cooperadores en 18 zonas tropicales principales. Se seleccionan algunas de las variedades probadas en SPOT para ser introducidas a ISVEX, la última de la serie de pruebas internacionales.

Solamente 16 variedades de soya de adaptabilidad comprobada pueden incluírse en ISVEX cada año. Sin embargo, los cooperadores pueden sustituir una o dos variedades locales para comparación. Se les aconseja a los cooperadores que seleccionen las variedades de ISVEX mejor adaptadas a las condiciones locales para evaluación en adicionales experimentos agronómicos y para, una vez que se ha aumentado el surtido de semillas, presentarlas directamente a los agricultores.

Durante los siete años de funcionamiento, cooperadores de 112 países han participado en ISVEX. Sesenta y cinco variedades se han introducido y evaluado en zonas ambientales que van desde zonas bajo el nivel del mar hasta otras a más de 1.800 metros, y desde latitudes de 40°N a otras de 40°S. Se han evaluado 88 variedades adicionales através de SIEVE y SPOT.

Los resultados de seis años de evaluación de variedades han demostrado que las cepas desarrolladas en zonas templadas pueden producir grandes rendimientos bajo condiciones experimentales en el trópico y subtrópico. Se ha encontrado que el ya existente germoplasma es más flexible y más extensamente adaptable de lo que se esperaba. Los rendimientos experimentales han producido, por término medio, entre 2.200 y 3.000 kg/ha, y en lugares seleccionados, los rendimientos han ido desde 4.000 a 6.000 kg/ha. El contenido de proteína de la soya cultivada en zonas tropicales es comparable al de la soya cultivada en zonas templadas.

El potencial de rendimiento de las cepas cultivadas

en el trópico no siempre está relacionado al grupo de madurez. Por ejemplo, la cepa Davis, ubicada en el grupo IV, constantemente ha rendido más que las variedades de maduración más tardía en casi todas las latitudes y altitudes. La cepa Williams, ubicada en el grupo III, ha producido rendimientos más grandes que los de algunos tipos de maduración más tardía, aunque florecen más temprano y no alcanzan tanta altura. No obstante, como grupo, las cepas de maduración más tardía rinden más que las de maduración más temprana.

Las variedades florecieron más temprano y no crecieron tan altas bajo condiciones de reducidas horas de luz cerca del ecuador y bajo temperaturas nocturnas más bajas a mayores altitudes. El crecimiento de plantas parece ser afectado más por los cambios de altitud que por las variaciones en las horas de luz. El número de los días desde la floración hasta la maduración fue notablemente similar entre las variedades a pesar de la deferencia del período de tiempo entre la siembra y la floración.

La mayoría de las cepas de Estados Unidos rindieron muy bien al cultivarse en ambientes tropicales y produjeron semillas de alta calidad. El encame de plantas y el desgrane de semillas no fueron problemas serios. Las características agronómicas para prevenir que se encamen las plantas y se desgranen las semillas son muy deseables y pueden ser incorporadas a variedades que posean mayor adaptabilidad al período diurno y a las condiciones de temperatura del ambiente local.

Entre todas las variedades evaluadas no hubo relación significante entre el tamaño de la semilla y los rendimientos de la cosecha. Sin embargo, se encontró que, dentro de una sola variedad, tanto más grande la semilla, más abundante el rendimiento.

El análisis de las fuentes de variación en los resultados de ISVEX indican que los rendimientos producidos de la misma variedad de soya pueden ser afectados más por las técnicas de manejo que por las condiciones ambientales. El manejo agronómico constituye un aspecto muy importante del éxito del cultivo de soya.

Como resultado de haber realizado pruebas de ISVEX, muchos países han encontrado que puede cultivarse la soya económicamente y con mucho éxito. Egipto ha seleccionado tres variedades para la producción comercial, después de haber evaluado distintas variedades durante algunas temporadas principalmente através de las pruebas de ISVEX. Varios centenares de toneladas métricas de Calland, Clark 63 y Harosoy fueron importadas para el cultivo de 1977, y 2.000 toneladas fueron importadas para la estación de 1978. Estas semillas proporcionaron la base para la rápida y eficaz expansión de hectáreas comerciales. Egipto ha aumentado el rendimiento por hectárea, ha duplicado el área bajo cultivo cada año desde 1974 hasta 1978, y ha establecido un programa de multiplicación de semilla dentro del país. La producción comercial ahora ha sobrepasado las 40.000 hectáreas.

El Irán, la Costa de Marfil, el Paquistán, las Islas Filipinas y Siria han importado grandes cantidades de semilla para la producción de soya; Benin, la India, Kenia, Marruecos, Somalía y Sudán han comprado cantidades menores. La importación de semilla ha estimulado programas nacionales de producción de granos leguminosos para semilla y ha permitido el desarrollo de programas de investigación, de extensión y de multiplicación de semilla — factores esenciales para un programa nacional viable y consistente.

Através del programa de evaluación de soya de INTSOY, se ha estudiado cómo reaccionan las diversas variedades a distintos ambientes específicos. Muchos países con potencial para el cultivo de soya destinado a alimentación humana, han iniciado ya la producción. INTSOY sigue proporcionando apoyo a los programas através del desarrollo y la introducción de variedades de amplio espectro de adaptación y resistencia a insectos, enfermedades y nematodas. El desarrollo de variedades y la evaluación de las mismas tiene que seguir sin interrupción debido a los sistemas biológicos dinámicos y a los diversos patrones de cultivo.

JUBILACION DE ABRAMS

El Dr. Raúl Abrams se retiró de sus cargos como Director Asociado de INTSOY y Director de la Estación Experimental Agrícola de Puerto Rico, el 31 de enero de 1980. El Dr. Abrams, quien ha estado asociado a INTSOY desde sus comienzos, ha sido instrumento valioso en el éxito del programa cooperativo inter-institucional de soya de INTSOY.

CAMBIO EN EL PERSONAL EN PUERTO RICO

El Dr. W. C. Stearn reemplazará al Dr. R. Stewart Smith como Microbiólogo de Suelos en Puerto Rico. El Dr. Stearn, quien obtuvo su PhD en la Universidad del Estado de Ohio, tomará posesión de su cargo a mediados de febrero. El Dr. Smith es ahora Director de Investigaciones y Desarrollo en la compañía Nitragin en Milwaukee, Wisconsin, Estados Unidos.

INTSOY es un programa de la Universidad de Illinois, en Urbana-Champaign, y la Universidad de Puerto Rico, Recinto de Mayagüez, que coopera con organizaciones nacionales e internacionales a fin de propagar el uso de la soya para la alimentación humana. INTSOY proporciona igualdad de oportunidades en programas y empleos. INTSOY Newsletter está subvencionado en parte por la Agencia para el Desarrollo Internacional de los Estados Unidos (USAID). Los puntos de vista y las interpretaciones que aparecen en este Newsletter son exclusivos de INTSOY y no se deben atribuir a USAID ni a ninguna otra agencia o persona que actúe en su nombre.

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N° 20, FEVRIER 1980

POINTS CULMINANTS DE LA RECHERCHE INTSOY: LE PROGRAMME D'AMELIORATION GENETIQUE DU SOJA

Le but de ce programme est d'identifier et de développer un rendement optimum, des variétés de soja nutritives propres à la reproduction dans des régions tropicales et subtropicales. Le siège du programme de reproduction d'INTSOY se trouve à Puerto Rico où les acquisitions et les variétés de soja développées par les reproducteurs coopérants sont cultivées dans le but d'identifier les caractéristiques souhaitées. Ces caractéristiques sont ensuite introduites dans les variétés existantes. On procède à des croisements pour produire des groupes isolés parmi lesquels on peut sélectionner des modèles de classe supérieure. Les caractéristiques étudiées comprennent: une insensibilité photopériodique, une résistance aux maladies et aux insectes, l'acquisition d'une enveloppe dure de la graine, et la conservation de la qualité de la graine dans un milieu tropical.

On a procédé à une série d'essais afin d'identifier et d'évaluer les variétés les plus promettantes à partir de nombreuses sources mondiales. Ces essais comprennent: SIEVE, Test International d'Evaluation des Variétés de Soja; SPOT, Essai d'Observation Préliminaire du Soja; et ISVEX, Test d'Evaluation des Variétés Internationales de Soja. INTSOY procure les graines, l'inoculant, les feuilles de relevés de données et les procédures à suivre pour les essais. Le coopérateur fournit la terre, le fertilisant et la gestion. Au cours des tests, le coopérateur rassemble les données de rendement et des caractéristiques agronomiques.

On communiquera également des renseignements complémentaires concernant l'emplacement et les conditions d'environnement. Des échantillons de graines de chaque variété sont renvoyés à INTSOY aux fins d'analyses de protéines et d'huile. Les résultats des essais sont ensuite analysés et interprétés pour déterminer l'effet de la latitude et de l'altitude sur des variétés particulières et sur des groupes de maturité et types de plants.

Les tests SIEVE enregistrent les nombreuses sources de variétés de soja améliorées du monde entier. Les reproducteurs de plants sont invités à fournir leurs meilleures variétés améliorées ayant atteint le stade de production F_6 ou un stade ultérieur. Ces cultivars sont ensuite plantés à diverses latitudes en Ecuador, à Puerto Rico et aux Etats-Unis. Les essais sont contrôlés par des coopérateurs et par les cadres de l'INTSOY. Après la multiplication, à Puerto Rico, des graines des variétés sélectionnées à partir de SIEVE, celles-ci sont enregistrées dans le SPOT. SIEVE constitue donc le premier maillon dans l'évaluation des variétés et le chaînon d'introduction allant du reproducteur de plants au fermier.

Le maillon suivant est SPOT qui procure une évaluation complémentaire du plasma germatif dans nombre de types d'environnements. Actuellement, 15 à 25 variétés sont évaluées chaque année par des coopérateurs dans 18 zones tropicales majeures. Quelques-unes des variétés testées dans SPOT sont sélectionnées pour être enregistrées dans ISVEX, le dernier d'une série d'essais internationaux.

Chaque année, 16 variétés de soja seulement, dont l'adaptabilité a été prouvée, peuvent participer à ISVEX. Toutefois, les coopérateurs peuvent substituer une ou deux variétés locales en tant qu'élément de comparaison. On encourage les coopérateurs à sélectionner les variétés ISVEX les mieux adaptées aux conditions locales en vue d'évaluations ultérieures des tests agronomiques sur la récolte, et après l'augmentation des graines, en vue de l'introduction directe aux fermiers.

Des coopérateurs de 112 pays ont participé à ISVEX au cours de ses sept années d'activités. Soixante-cinq variétés ont été introduites et évaluées dans des zones d'environnement allant d'un niveau inférieur à celui de la mer jusqu'à 1.800 mètres audessus de ce niveau, et d'une latitude de 40°N à 40°S. Quatre-vingt-huit variétés et acquisitions supplémentaires ont été évaluées au moyen de SIEVE et de SPOT.

Les résultats obtenus au cours de six ans d'évaluation de variétés ont prouvé que les cultivars développés dans des zones tempérées peuvent donner de gros rendements dans des conditions expérimentales dans les régions tropicales et subtropicales. On a vu que le plasma germatif présent était plus souple et plus généralement adapté que prévu. La moyenne du rendement expérimental a varié entre 2.200 et 3.000 kg/ha et, à des endroits choisis, de 4.000 à 6.000 kg/ha. Le contenu en protéines du soja cultivé sous les tropiques était comparable à celui du soja cultivé dans les zones tempérées.

Le potentiel de rendement des cultivars poussant

sous les tropiques n'est pas toujours lié au groupe de maturité. Par exemple, Davis, dans le groupe IV, a constamment eu un rendement supérieur à d'autres variétés à maturation tardive, à presque toutes les latitudes et altitudes. Williams, dans le groupe III, a eu un rendement supérieur à celui des types à maturation tardive, malgré une floraison précoce et une hauteur moindre. Toutefois, en tant que groupe, les cultivars à maturation tardive ont un plus grand rendement que les cultivars à maturation précoce.

Les variétés ont fleuri plus tôt et n'ont pas grandi autant dans le cas de jours plus courts près de l'équateur et dans le cas de nuits plus fraîches à haute altitude. La croissance des plants semble être plus influencée par des changements d'altitude que par la longueur des jours. Le nombre de jours entre la floraison et la maturité était nettement similaire parmi les variétés, sans se préoccuper du temps requis entre la plantation et la floraison.

La plupart des cultivars des Etats-Unis ont bien réagi lorsqu'ils étaient cultivés dans un milieu tropical et ont produit des graines de haute qualité. Le couchage des plants et l'éclatement des graines n'ont pas créé de gros problèmes. Les caractéristiques agronomiques destinées à empêcher le couchage et l'éclatement sont fortement appréciées et peuvent être incorporées dans les acquisitions ayant une plus grande adaptabilité locale à la longueur des jours et aux conditions de température ambiante.

Parmi toutes les variétés évaluées, il n'y a pas eu de relation importante entre le format de la graine et le rendement. Toutefois, au sein d'une même variété, plus la graine est grande, plus le rendement sera important.

L'analyse des sources de variations dans les résultats de l'ISVEX indique que le rendement de la même variété de soja peut être plus influencée par les techniques de gestion que par les conditions d'environnement. Une gestion compétente de la récolte représente une part nettement importante de la réussite dans la culture du soja.

Suite aux essais ISVEX, beaucoup de pays ont vu que le soja pouvait être cultivé avec succès et économiquement. L'Egypte a sélectionné trois variétés pour la production commerciale après avoir évalué les variétés au cours de plusieurs saisons, et ce au moyen des essais ISVEX. Plusieurs centaines de tonnes métriques de Calland, de Clark 63 et d'Harosoy ont été importées pour la récolte de l'année 1977 et 2.000 tonnes ont été importées pour la saison 1978. Cette graine a été à la base d'une expansion réussie et rapide d'hectares commerciaux. L'Egypte a accru son rendement par hectare, chaque année a doublé l'ère protégée, de 1974 à 1978 incluse, et établi un programme de multiplication des graines au sein du pays. La production commerciale a maintenant dépassé 40.000 hectares.

L'Iran, la Côte d'Ivoire, le Pakistan, les Philippines et la Syrie ont importé de grandes quantités de graines pour la production du soja; le Bénin, l'Inde, le Kenya, le Maroc, la Somalie et le Soudan ont acheté des quantités inférieures. L'importation de graines a encouragé les programmes de graines pour la production de graines de légumes, tout en permettant le développement de la recherche, l'extension et les activités de multiplication de graines pour un programme régional viable et conséquent.

On a étudié la réaction de variétés à nombre de milieux déterminés au moyen du programme d'évaluation du soja INTSOY. Beaucoup de pays ayant un potentiel pour la culture du soja en ont commencé la production. INTSOY continue à fournir son aide au moyen du développement et de l'introduction de variétés améliorées ayant une grande adaptabilité et résistance aux insectes, maladies et nématodes. Le développement et l'évaluation des variétés ne doivent pas être interrompus à cause de systèmes biologiques et dynamiques et des types de récoltes variées.

LA RETRAITE DE M. ABRAMS

Raul Abrams a pris sa retraite en tant que Directeur-Adjoint de l'INTSOY et Directeur du Poste d'Essais d'Agriculture de Puerto Rico, le 31 janvier 1980. Affilié à l'INTSOY depuis sa création, Dr. Abrams a grandement contribué au succès du programme INTSOY pour la coopération entre les diverses organisations s'occupant de la culture du soja.

CHANGEMENT DE CADRES A PUERTO RICO

W. C. Stearn succédera en tant que microbiologiste de l'INTSOY à R. Stewart Smith. Dr. Stearn, qui a un doctorat de l'Université d'Etat de l'Ohio (E-U), assumera ces fonctions dès la mi-février. Dr. Smith est maintenant Directeur de Recherches et de Développement à Nitragin Co., à Milwaukee, Wisconsin (E-U).

INTSOY est un programme de l'Université d'Illinois à Urbana-Champaign (E-U) et de l'Université de Puerto Rico, Campus de Mayaguëz, en coopération avec des organisations internationales et nationales dans le but de généraliser l'usage du soja pour l'alimentation humaine. INTSOY ne pratique de discrimination ni dans le domaine de l'emploi ni dans ses programmes. L'INTSOY Newsletter est partiellement subventionnée par l'Agence Américaine pour le Développement International (USAID); les points de vue et interprétations sont ceux de l'INTSOY et ne pourraient être attribués ni à USAID ni à aucune personne représentant cette organisation.

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NO. 21, MAY 1980

INTSOY RESEARCH HIGHLIGHTS: SOYBEAN VIRUSES AND THEIR VECTORS

INTSOY's research program includes work on the detection and characterization of soybean viruses, mechanisms and control of virus transmission through seeds, identification and sampling of insect vectors, and development of improved varieties with resistance to viral diseases. Ecological studies are helping us to determine economically damaging levels of viruses and vectors, as well as genetic and cultural ways to minimize losses.

Soybean mosaic virus (SMV) causes an economically important disease in several tropical and subtropical countries. The virus is transmitted from season to season and from one geographical area to another through seeds. In the field, SMV is spread by aphids. Because soybean germplasm collections contain SMV-infected seeds, the danger of seed-borne spread is present whenever germplasm exchanges occur.

SMV isolates differ in their virulence, or ability to infect soybean cultivars, and in their ability to inflict yield losses. INTSOY classified SMV isolates into seven strains according to differences in virulence. Differentiation of strains is an important step in producing virus-resistant varieties, because some may be resistant to one strain but susceptible to others. SMV strain differentials are available to cooperators for determining which strains are present in their area.

INTSOY has identified several tropical soybean lines that are resistant to SMV. These lines have been used with the seven SMV strains to study the mode of inheritance of resistance. Results indicate that at least two dominant genes at different loci are involved. We used tropically adapted cultivars as susceptible parents and thus made an early start in introducing genes for SMV resistance into tropically adapted varieties. Soon, progeny from this program will be among advanced soybean lines distributed by INTSOY to its cooperators worldwide.

Research results are being applied to reduce transmission of SMV through seeds. The incidence of seed transmission in soybeans is typically 5 to 20 percent. INTSOY screened nearly 900 lines and identified several tropical lines with less than 0.5 percent seed transmission. This result suggests a means of controlling the virus by using genetic resistance to seed transmission. Another means is to harvest seeds from only those plants shown to be free of viruses. This approach is being used in a cooperative project of the International Institute of Tropical Agriculture (IITA) and INTSOY to produce a virus-free, tropical germplasm collection for national and international soybean programs in Africa. In the first stage of this project, about 450 tropical lines are being freed of viral infection.

Many, but not all, aphid species transmit SMV. Because virus spread in soybean fields is so dependent on the species of aphids and the time when they are active, we developed a new type of insect trap for determining species and the number of each alighting in a field. At one location we found more than eighty species. INTSOY cooperators in several countries are now using the trap.

To identify the species carrying SMV, INTSOY has developed a method with simple equipment that can be readily used in the tropics. In one study, four species were responsible for more than 90 percent of the SMV spread.

In most parts of the world, aphids are usually transient and do not colonize soybeans. They alight in fields, pick up the virus when probing infected plants, and then carry it to healthy ones. How can aphid vectors of a nonpersistently transmitted virus like SMV be controlled in the field? Insecticides are ineffective because they kill the vectors too slowly. However, vectors can be manipulated by delaying their time of flight, lowering their landing frequency in fields, changing planting dates, altering the color of the soybean canopy, and imposing plant barriers between the infected soybeans and those we wish to protect. These cultural controls are especially important for protecting seed production fields.

INTSOY is currently investigating the relative transmissibility of SMV strains by aphid vectors and the threshold below which SMV inoculum and vectors can be tolerated without yield loss. Data on yield loss are being incorporated into a computer-based model of SMV epidemiology. The results will be evaluated under tropical and subtropical conditions where SMV is a problem. We encourage your participation in our research and evaluations.

INTSOY has played a major role in the discovery of geminiviruses, a new class of plant pathogenic virus found predominantly in the tropics. Transmitted in nature by whiteflies or leafhoppers, these viruses affect many important tropical crops including soybeans. Geminiviruses are the smallest viruses yet discovered and the first from plants having single-stranded DNA. One of these unusual viruses is being used to study the mechanisms by which genetic information is organized and expressed in plants. Sponsored in part by INTSOY, this research should lead to a better understanding of plant genetics and to advances in plant breeding and yield improvement.

The research team is led by R. M. Goodman, virologist, and M. E. Irwin, entomologist, who work with the INTSOY breeding and seed pathology programs. Information is available from members of the team upon request.

SEED QUALITY CONFERENCE

A conference on soybean seed quality and stand establishment will be held in Sri Lanka from January 26 to 30, 1981. The conference is sponsored by the Sri Lanka Ministry of Agricultural Development and Research, the Seed Technology Program of Mississippi State University, and INTSOY in collaboration with the Food and Agriculture Organization of the United Nations (FAO) and the U.S. Agency for International Development. Only one conference on this subject is planned — *not* three regional conferences as announced in the August, 1979, INTSOY Newsletter.

SOYCRAFTERS CONFERENCE

The Third Soycrafters Conference will be held at the University of Illinois from July 9 to 13, 1980. Sponsored by Soycrafters Association of North America in conjunction with the U.S. Department of Agriculture's Northern Regional Research Center, the University of Illinois at Urbana-Champaign, and INTSOY, the conference will highlight human food made from soybeans.

NEW PUBLICATIONS

Number 19 in the INTSOY Publication Series is now available: "International Soybean Variety Experiment, Fifth Report of Results, 1977" by W. H. Judy and H. J. Hill. Number 18, "Sources of Resistance to Selected Fungal, Bacterial, Viral and Nematode Diseases of Soybeans," by O. Tisselli, T. Hymowitz, and J. B. Sinclair will be available within a few weeks.

"Recetario: Frijol Soya" contains 96 pages of soybean recipes developed by Carmen Echeandia de Calderon of the Instituto de Investigaciones Agro-Industriales (IIA) in Lima, Peru. This book of recipes in Spanish was published through Peru's Proyecto Integral de Desarrollo de la Soya. Single copies are available from INTSOY or from IIA, Apartado 11294, Lima 14, Peru.

SOYBEAN PRODUCTION COURSE

The Instituto Colombiano Agropecuario (ICA) and INTSOY are presenting a soybean production training course for research, extension, and production personnel from Spanish-speaking countries. This three-week course will be held in Palmira, Colombia, beginning November 24, 1980. Cost per participant is US$900. Write INTSOY or ICA, Apartado Aereo 233, Palmira, Colombia, for more information.

INTSOY is a program of the University of Illinois at Urbana-Champaign and the University of Puerto Rico, Mayagüez Campus, cooperating with international and national organizations to expand the use of soybeans for human food. INTSOY provides equal opportunities in programs and employment. The INTSOY Newsletter is partially supported by the U.S. Agency for International Development; the views and interpretations are those of INTSOY and should not be attributed to USAID or to any individual acting in their behalf.

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NO. 22, AUGUST 1980

INTSOY RESEARCH HIGHLIGHTS: PROGRAM IN INSECT PEST MANAGEMENT

When invited, INTSOY will help a country to develop a broadly based soybean program. Pest management, an integral part of crop management, is important to these programs, especially in the tropics and subtropics. The objective is to keep pest populations below damaging levels with methods that are economical and environmentally sound. A pest management program gives the grower options suited to the situation.

The INTSOY insect pest management program can adjust to new locations, pests, and control methods. It can be expanded to include soybean diseases, nematodes, weeds, and vertebrate pests. It can also form the basis of similar programs for other crops.

The program has three steps. First, the major insect pests of soybeans are identified. Then the entomological literature is searched, using the scientific names, for information about the insects.

Second, information on monitoring procedures, economic thresholds, and insecticide dosages is used to set up a preliminary, supervised control program. This program involves extension personnel and soybean growers. In-country researchers undertake a one-year study of the phenology and population dynamics of pest species and natural enemies. Thus, at the outset, pest management programs function at the grower level.

Finally, the results of the initial program are evaluated. Economic thresholds and insecticide dosages are adjusted to local conditions. Alternate strategies, including biological control, plant breeding for pest resistance, and cultural control, are investigated in a longer-term project.

Two units, sponsored in part by INTSOY, provide the information necessary in the first step. The International Reference Collection of Soybean-Associated Arthropods (IRCSA) identifies insect specimens collected in soybean fields. Information available within the country is also used. Then the Soybean Insect Research and Information Center (SIRIC) performs the literature searches. More information on IRCSA and SIRIC is available in INTSOY Newsletter No. 18, August 1979.

INTSOY entomologists oversee the insect pest management programs. One of these programs is beginning its second year in the high jungle zones of Peru. So far, two of the program's three steps have been implemented. Data are now emerging on the phenology and population dynamics of soybean insects.

In Peru, several insect pests have moved to soybeans from weeds. *Grammopsoides rufipes,* a cerambycid stem-boring beetle, is an example. Very little information is available about soybean stem-boring cerambycids, and nothing is known about economic thresholds, sampling procedures, or chemical control. A Peruvian entomologist, while determining the importance of this insect as a pest, discovered that the stem-borer has thirteen host plants — including weeds, crops, and flowers — near soybean fields. Information gathered on the effects of this insect on soybean yields is undergoing statistical analysis.

Soybean workers in Peru also observed that one of the pesticides, even though used at recommended dosages, was not lowering target populations to subeconomic damage levels. A study is underway to determine if this observation was accurate, and if so, why the pesticide was ineffective. Perhaps the pest is resistant to the insecticide. Or perhaps the local formulation of the chemical or application procedures were at fault. The insect pest management program in the high jungle of Peru has been a valuable testing ground for INTSOY's developing concepts of crop protection.

INTSOY does some of the initial research at the University of Illinois. One example is a study of insect monitoring methodology. Monitoring procedures and devices developed in soybean fields in Illinois have been transferred directly to several other countries. Our work on monitoring winged aphids is summarized in the February 1980 issue of the INTSOY Newsletter. The same technique can be used to monitor the activity of thrips in soybean fields. Thrips do not usually cause significant yield reductions. However, some species are capable of transmitting tobacco ringspot virus, a bud blight of soybeans. It is therefore important to monitor thrips activity in infested areas.

INTSOY entomologists are also exploring biological control using insect predators that search out

and eat the eggs of soybean-defoliating caterpillars. If the predator population is augmented early in the season, the caterpillars will not reach economic threshold levels. Under investigation is the use of odors to attract predators to infested fields.

The purpose of a related project is to attract predators early in the season by artificially infesting soybean fields with prey that are not harmful to soybeans. Predator populations will then be ready for pests when they arrive. Manipulation and augmentation of existing natural enemies is an economical and environmentally safe way of keeping pests from reaching economic thresholds.

Michael E. Irwin is head of INTSOY's insect pest management program. John K. Bouseman is in charge of IRCSA, Jenny Kogan is in charge of SIRIC, and Marcos Kogan directs the Illinois soybean pest management program. More information is available from members of the team upon request.

SEED QUALITY CONFERENCE

The Soybean Seed Quality and Stand Establishment Conference will be held in Colombo, Sri Lanka, from January 25 to 31, 1981, as announced in earlier Newsletters. Contact INTSOY for more information.

SOYBEAN SHORT COURSES COMPLETED

Certificates were recently awarded to participants in the two INTSOY-sponsored soybean short courses. There were eleven participants in the Technical and Economic Aspects of Soybean Production Course: Lewis R. Msika, Zimbabwe; Lech R. Boros, Poland; Abdel Ghany El-Faramaway Mohamed Sharaf, Egypt; Sulaiman Dawood Sulaiman, Iraq; Pierre Josué, Haiti; Goli Ankon and Kouame Komenan Pierre, Ivory Coast; and Gamalathge A. Gunatilaka, Tharmalingam Ramachandra, Kulasiri Ranaweera, and Mervyn R. Yainne, Sri Lanka.

Attending the Soybean Processing for Food Uses Course were: Peter A. Hicks, Australia; Gaye Yamar, Senegal; Priscilla C. Sanchez, Philippines; Ellen Jayawardene, Sri Lanka; Masimba Nigel Munyati, Zimbabwe; Warunee Varanyanond and Ajarie Visessiri, Thailand; Subari Bin Shibani, Bahari Bin Ismail, and Siti Meriam Binti Ahmad, Malaysia; Joisher Kalki and L. B. Rawlani, India; Javier Saenz de la Calle, Spain; and Ayman Mohamed Sinno, Egypt.

This is the sixth year that these courses were offered. L. S. Wei, Department of Food Science of the University of Illinois, was technical leader for the soybean processing course, and John W. Santas, INTSOY, was leader of the soybean production course.

WORLD SOYA PROCESSING CONFERENCE

The World Conference on Soya Processing and Utilization will be held in Acapulco, Mexico, from November 9 to 14, 1980. The purpose of the conference is to transmit information about the processing and use of soybeans, particularly to nations that could use soybeans to improve their diets.

Cosponsoring the conference with the American Oil Chemists' Society are: American Soybean Association, the National Association of Manufacturers of Edible Fats and Oils of Mexico, the U.S. Agency for International Development, the USDA Foreign Agricultural Service, the USDA Science and Education Administration, and the State of Guerrero, Mexico. INTSOY is a participating organization.

Additional information is available from the American Oil Chemists' Society, 508 S. Sixth Street, Champaign, Illinois 61801, USA.

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NO. 22, AGOSTO DE 1980

ASPECTOS DESTACADOS EN LAS INVESTIGACIONES DE INTSOY: PROGRAMA PARA EL MANEJO DE PLAGAS DE INSECTOS

En caso de ser invitado por un país, INTSOY contribuirá al desarrollo de un programa amplio para la soya. El manejo de plagas, parte integral del manejo de cultivos, es muy importante para estos programas, especialmente en las áreas tropicales y subtropicales. El objectivo es mantener las poblaciones de plagas por debajo de los niveles dañinos, con métodos viables tanto desde el punto de vista ambiental como económico. Un programa de manejo de plagas ofrece al agricultor opciones adecuadas a la situción.

El programa de manejo de plagas de insectos de INTSOY puede adaptarse a nuevas localidades, plagas y métodos de control. Puede ampliarse para incluir enfermedades de la soya, nematodos, malezas y plagas de vertebrados. También puede formar la base de programas similares para otros cultivos.

El programa consta de tres etapas. Primero se identifican las plagas más importantes de insectos de la soya. Luego se investiga la literatura entomológica, usando los nombres científicos, para obtener información acerca de los insectos.

Segundo, utilizando la información sobre procedimientos de observación, nivel máximo económicamente aceptable y dosis de insecticida, se establece un programa preliminar de control supervisado. Este programa incluye extensionistas y cultivadores de soya. Los investigadores del país emprenden un año de estudios sobre la fenología y dinámica de la población de las especies de plagas y enemigos naturales. Así, al principio, los programas de manejo de plagas funcionan a nivel del agricultor.

Finalmente, los resultados del programa inicial son evaluados. Se adaptan los umbrales económicos y dosis de insecticida a las condiciones locales. En un proyecto a más largo plazo se investigan estrategias alternativas, incluyendo control biológico, cultivo de plantas para obtener resistencia a la plaga y control cultural.

Dos unidades, patrocinadas parcialmente por INTSOY, proveen la información necesaria en la primera etapa. La International Reference Collection of Soybean-Associated Arthropods (IRCSA) (Colección Internacional de Referencias Sobre los Artrópodos Asociados con la Soya) identifica especímenes de insectos recogidos en campos de soya. También se utiliza la información disponible en el país. Luego el Soybean Insect Research Information Center (SIRIC) (Centro de Información Sobre Investigaciones de los Insectos de la Soya) realiza las indagaciones de la literatura. Para más amplia información sobre IRCSA y SIRIC consulte la INTSOY Newsletter No. 18 de agosto de 1979.

Los entomólogos de INTSOY supervisan los programas de manejo de plagas de insectos. Uno de estos programas está comenzando su segundo año en las zonas de selva alta del Perú. Hasta ahora se han implementado dos de las tres etapas del programa. Ya están apareciendo datos sobre la fenología y dinámica de las poblaciones de insectos de soya.

En el Perú varias plagas de insectos se han trasladado desde las malezas a la soya. Un ejemplo es el *Grammopsoides rufipes,* un escarabajo cerambicido barrenador del tallo. Hay muy poca información disponible sobre este tipo de insectos y no se sabe nada acerca de los umbrales económicos, los procedimientos de muestreo o el control químico. Un entomólogo peruano, mientras determinaba la importancia de este insecto como plaga, descubrió que el barrenador del tallo tiene trece plantas huéspedes — incluyendo malezas, cultivos y flores — cerca de los campos de soya. La información recogida sobre los efectos de este insecto en el rendimiento de los cultivos de soya está siendo sometida a un análisis estadístico.

Trabajadores de la soya en el Perú observaron también que uno de los pesticidas, aun cuando se lo usa en las dosis recomendadas, no reduce las poblaciones tratadas a niveles de daños subeconómicos. Se está efectuando un estudio para determinar si esta observación ha sido exacta y, si lo fue, porqué no ha sido efectivo el pesticida. Quizás la plaga sea resistente al insecticida, talvez la formulación local de la sustancia química o sus procedimientos de aplicación fueron defectuosos. El programa de manejo de plagas de insectos en la selva alta del Perú ha sido un valioso terreno de ensayo para los conceptos de protección de cultivos que está desarrollando INTSOY.

INTSOY efectúa parte de la investigación inicial en la Universidad de Illinois. Un ejemplo es un estudio de metodología para la detección de insectos. Los procedimientos y técnicas de detección desarrollados en los campos de soya en Illinois han sido transferidos directamente a varios otros países.

Nuestro trabajo de observación de los áfidos alados está resumido en la INTSOY Newsletter de febrero de 1980. Se puede utilizar la misma técnica para observar la actividad de los trips (Thysanoptera) en los campos de soya. Usualmente los trips no causan reducciones significativas del rendimiento. Sin embargo, algunas especies son capaces de transmitir el virus de la mancha anular del tabaco, una enfermedad de la yema de la soya, por lo cual es importante observar la actividad de los trips en las áreas infestadas.

Los entomólogos de INTSOY están también examinando el control biológico mediante el uso de depredadores de insectos que ubican y comen los huevos de las orugas defoliadoras de la soya. Si se aumenta la población de depredadores al comienzo de la estación, las orugas no alcanzarán los niveles del umbral económico. Se está investigando el uso de olores para atraer depredadores a los campos infestados.

El objetivo de un proyecto relacionado es atraer los depredadores al comienzo de la estación, infestando artificialmente los campos de soya con presas que no sean dañinas para la soya. De esta manera, las poblaciones de depredadores estarán listas para las plagas cuando éstas arriben. La manipulación y aumento de los enemigos naturales existentes es una forma segura ambiental y económicamente para impedir que las plagas alcancen los umbrales económicos.

El Dr. Michael E. Irwin está en cargado del programa de manejo de plagas de insectos de INTSOY. El Sr. John K. Bouseman está a cargo de IRCSA, la Sra. Jenny Kogan está a cargo de SIRIC, y el Dr. Marcos Kogan dirige el programa de manejo de plagas de soya en Illinois. A petición de los interesados, los miembros de este equipo proveerán información al respecto.

CONGRESO SOBRE CALIDADES DE SEMILLA

El Congreso Sobre Calidades de Semilla y Establecimiento de Plantíos de Soya se realizará en Colombo, Sri Lanka, del 25 al 31 de enero de 1981, tal como anunciado en las Newsletters anteriores. Para mayor información póngase en contacto con INTSOY.

SE CLAUSURAN CURSILLOS SOBRE LA SOYA

Recientemente se han entregado diplomas a los participantes de dos cursillos sobre la soya patrocinados por INTSOY. El Curso de Aspectos Técnicos y Económicos de la Producción de Soya contó con once participantes: Lewis R. Msika, Zimbabwe; Lech R. Boros, Polonia; Abdel Ghany El-Faramaway Mohamed Sharaf, Egipto; Sulaiman Dawood Sulaiman, Iraq; Pierre Josué, Haití; Goli Ankon y Kouame Komenan Pierre, Costa de Marfil; y Gamalathge A. Gunatilaka, Tharmalingan Ramachandra, Kulasiri Ranaweera y Mervyn R. Yainne, Sri Lanka.

Los participantes del Curso Sobre el Procesamiento de Soya para Usos Alimenticios fueron: Peter A. Hicks, Australia; Gaye Yamar, Senegal; Priscilla C. Sánchez, Filipinas; Ellen Jayawardene, Sri Lanka; Masimba Nigel Munyati, Zimbabwe; Warunee Varanyanond y Ajarie Visessiri, Tailandia; Subari Bin Shibani, Bahari Bin Ismail y Siti Meriam Binti Ahmad, Malasia; Joisher Kalki y L. B. Rawlani, India; Javier Saenz de la Calle, España; y Ayman Mohamed Sinno, Egipto.

Estos cursos ya han sido ofrecidos durante seis años. El Dr. L. S. Wei, del Departamento de Ciencia de los Alimentos de la Universidad de Illinois, fue el director técnico del curso sobre el procesamiento de la soya, y el Dr. John W. Santas, de INTSOY, fue el director del curso sobre la producción de soya.

CONFERENCIA SOBRE EL PROCESAMIENTO DE LA SOYA

La Conferencia Mundial Sobre el Procesamiento y la Utilización de la Soya se llevará a cabo en Acapulco, México, del 9 al 14 de noviembre de 1980. El objetivo de esta conferencia es transmitir información sobre el procesamiento y uso de la soya, especialmente a las naciones que podrían utilizar la soya para mejorar sus dietas alimenticias.

Patrocinan la conferencia conjuntamente con la Sociedad Americana de Químicos en Aceites (AOCS): la Asociación Americana de Soya (ASA), la Asociación Nacional de Industriales de Aceites y Grasas Comestibles de México, la Agencia para el Desarrollo Internacional de EUA (USAID), el Servicio Exterior (FAS) y la Administración para la Ciencia y la Educación (SEA) del Departamento de Agricultura de EUA (USDA) y el Estado de Guerrero, México. INTSOY es una organización participante.

Para obtener información adicional, diríjase a: American Oil Chemists' Society, 508 S. Sixth Street, Champaign, Illinois 61801, USA.

INTSOY es un programa de la Universidad de Illinois, en Urbana-Champaign, y la Universidad de Puerto Rico, Recinto de Mayagüez, que coopera con organizaciones nacionales e internacionales a fin de propagar el uso de la soya para la alimentación humana. INTSOY proporciona igualdad de oportunidades en programas y empleos. INTSOY Newsletter está subvencionado en parte por la Agencia para el Desarrollo Internacional de los Estados Unidos (USAID). Los puntos de vista y las interpretaciones que aparecen en este Newsletter son exclusivos de INTSOY y no se deben atribuir a USAID ni a ninguna otra agencia o persona que actúe en su nombre.

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POINTS CULMINANTS DE LA RECHERCHE CHEZ INTSOY: PROGRAMME DE GESTION CONTRE LES INSECTES NUISIBLES

INTSOY aidera, sur invitation, un pays à développer sur une grande échelle un programme de culture du soja. La gestion contre les insectes nuisibles, qui fait partie intégrante de la gestion des cultures agricoles, est important dans ces programmes, particulièrement dans les pays tropicaux et subtropicaux. Il a pour but de maintenir les populations d'insectes nuisibles au-dessous des niveaux préjudiciables à l'aide de méthodes sûres tant sur le plan économique qu'écologique. Un programme de gestion des insectes donne au producteur des options convenant à la situation.

Le programme de gestion contre les insectes nuisibles d'INTSOY peut s'adapter à de nouveaux emplacements, insectes et techniques de contrôle. Il peut être développé et inclure les maladies du soja, les nématodes, les mauvaises herbes et les animaux nuisibles vertébrés. Il peut également constituer la base de programmes similaires pour d'autres cultures agricoles.

Le programme comporte trois étapes. La première consiste à identifier les principaux insectes nuisibles au soja, puis à faire des recherches dans la littérature entomologique, en utilisant la nomenclature scientifique, afin de s'informer sur les insectes.

La deuxième consiste à utiliser toutes informations sur les procédés de détection, les seuils économiques et les dosages d'insecticide afin d'établir un programme de contrôle préliminaire et supervisé. Ce programme concerne le personnel chargé du développement et les producteurs de soja. Des chercheurs indigènes entreprennent sur place une étude d'un an sur la phénologie et la dynamique de la population des espèces d'insectes nuisibles et d'ennemis naturels. Ainsi, dès le départ, les programmes de gestion contre les insectes nuisibles fonctionnent au niveau du producteur.

L'étape finale consiste à évaluer le programme initial. Les seuils économiques et les dosages d'insecticide sont adaptés aux conditions locales. Des stratégies alternatives, y compris un contrôle biologique, la culture de plantes pour résistance aux insectes nuisibles et la répression culturale font l'objet de recherches dans un projet à plus long terme.

Deux unités, sous le patronage d'INTSOY et d'autres, fournissent les informations nécessaires à la première étape. La International Reference Collection of Soybean-Associated Arthropods (IRCSA) (Collection internationale de référence des arthropodes associés au soja) identifie les spécimens d'insectes recueillis dans les champs de soja. On utilise également les renseignements disponibles à l'intérieur du pays. Ensuite le Soybean Insect Research Information Center (SIRIC) (Centre d'informations sur les recherches des insectes du soja) étudie la littérature appropriée. De plus amples informations sur IRCSA et SIRIC sont disponibles dans le No 18 d'INTSOY Newsletter d'août 1979.

Les entomologistes d'INTSOY surveillent les programmes de gestion contre les insectes nuisibles. Dans les régions à haute altitude de la jungle du Pérou, un de ces programmes est au début de sa deuxième année. Jusqu'à présent, deux des trois étapes du programme ont été exécutées. Actuellement des données sur la phénologie et la dynamique de population des insectes du soja sont en train d'émerger.

Au Pérou, de nombreux insectes nuisibles sont passés des mauvaises herbes aux champs du soja. Le *Grammopsoides rufipes,* un coléoptère cérambycide qui creuse des trous dans les tiges, est un exemple. Il existe très peu d'informations sur les cérambycides qui creusent des trous dans les tiges de soja, et l'on ignore tout des seuils économiques, des procédés d'échantillonnage ou du contrôle chimique. Un entomologiste péruvien, en train de déterminer l'importance de cet insecte, a aussi découvert que ce perceur de trous possède treize espèces de plantes hôtes près des champs de soja — y compris de mauvaises herbes, des cultures et des fleurs. Les informations recueillies sur les effets de ces insectes sur le rendement du soja font actuellement l'objet d'une analyse statistique.

Au Pérou, les ouvriers agricoles travaillant dans les champs de soja ont également observé que l'un des pesticides ne ramenait pas les populations d'insectes visées à des niveaux de dommages subéconomiques, bien que le dosage prescrit soit utilisé. Des recherches ont été entreprises afin de déterminer l'exactitude de cette observation et les causes de l'inefficacité du pesticide. Peut-être l'insecte nuisible était-il résistant à l'insecticide. Ou peut-être encore la formule locale du produit chimique ou les procédés d'application étaient-ils fautifs. Le programme de gestion contre les insectes nuisibles dans la jungle à haute altitude du Pérou a été une expérience précieuse pour les concepts de protection des récoltes d'INTSOY qui sont actuellement en voie de développement.

INTSOY fait quelques unes des recherches initiales à l'Université de l'Illinois. L'étude de la méthodologie de détection des insectes en est un exemple. Les procédés et moyens de détection développés dans les champs de soja de l'Illinois ont été transférés directement à plusieurs autres pays. Un résumé de notre travail sur la détection des pucerons ailés se trouve dans le numéro de février 1980 d'INTSOY Newsletter. La même technique peut s'utiliser pour détecter l'activité des thrips dans les champs de soja. Généralement, les thrips ne réduisent pas le rendement d'une manière significative. Cependant, quelques espèces sont capables de transmettre le virus en anneau de tabac (TRSV), une maladie affectant le bourgeon du soja; il est donc important de détecter l'activité des thrips dans les régions infestées.

Les entomologistes d'INTSOY sont également en train d'explorer le contrôle biologique en utilisant des insectes prédateurs qui cherchent et mangent les oeufs des chenilles responsables de la défoliation du soja. Si la population de prédateurs est augmentée au début de la saison, les chenilles n'atteindront pas le niveau de seuil économique. Actuellement l'utilisation des odeurs pour attirer les prédateurs dans les champs infestés fait l'objet de recherches.

Un projet connexe a pour but d'attirer les prédateurs au début de la saison en infestant artificiellement des espèces de proie qui ne présentent aucun danger pour les champs de soja. Les populations de prédateurs seront alors prêtes lors de l'arrivée des insectes nuisibles. La manipulation et l'accroissement des ennemis naturels existants est un moyen sûr tant sur le plan économique qu'écologique d'empêcher les insectes nuisibles d'atteindre les seuils économiques.

Michael E. Irwin est le chef du programme de gestion contre les insectes nuisibles d'INTSOY. John K. Bouseman est responsable d'IRCSA, Jenny Kogan de SIRIC, et Marcos Kogan dirige le programme de gestion contre les insectes nuisibles du soja de l'Illinois. Les membres de l'équipe vous fourniront sur demande de plus amples informations.

CONFERENCE SUR LA QUALITE DES SEMENCES

La conférence sur la qualité des semences de soja et sur l'implantation des plantes aura lieu à Colombo, Sri Lanka, du 25 au 31 janvier 1981, comme nous l'avons annoncé dans des Newsletters antérieurs. Pour de plus amples renseignements, s'adresser à INTSOY.

FIN DES COURS SUR LE SOJA

Les participants à deux cours sur le soja offerts par INTSOY viennent de recevoir leurs certificats. Le cours sur les aspects techniques et économiques de la production du soja comptait onze participants: Lewis R. Msika, Zimbabwe; Lech R. Boros, Pologne; Abdel Ghany El-Faramaway Mohamed Sharaf, Egypte; Sulaiman Dawood Sulaiman, Iraq; Pierre Josué, Haïti; Goli Ankon et Kouame Komenan Pierre, Côte d'Ivoire; et Gamalathge A. Gunatilaka, Tharmalingam Ramachandra, Kulasiri Ranaweera et Mervyn R. Yainne, Sri Lanka.

Peter A. Hicks, Australie; Gaye Yamar, Sénégal; Priscilla C. Sanchez, Philippines; Ellen Jayawardene, Sri Lanka; Masimba Nigel Munyati, Zimbabwe; Warunee Varanyanond et Ajarie Visessiri, Thaïlande; Subari Bin Shibani, Bahari Bin Ismail et Siti Meriam Binti Ahmad, Malaisie; Joisher Kalki et L. B. Rawlani, Inde; Javier Saenz de la Calle, Espagne; et Ayman Mohamed Sinno, Egypte, ont assisté au cours de traitement du soja pour usages alimentaires.

Ces cours sont offerts depuis six ans. L. S. Wei, du département de sciences alimentaires de l'Université de l'Illinois, était le directeur technique du cours de traitement du soja et John W. Santas d'INTSOY celui du cours de production du soja.

CONFERENCE MONDIALE DE TRAITEMENT DU SOJA

La conférence mondiale du traitement et de l'utilisation du soja aura lieu à Acapulco, Mexique, du 9 au 14 novembre 1980. Cette conférence a pour but de transmettre des informations sur le traitement et l'utilisation du soja, tout particulièrement aux nations qui pourraient l'utiliser pour améliorer leur alimentation.

La conférence est sous le patronage non seulement de American Oil Chemists' Society (Société américaine des chimistes de l'huile) mais aussi de American Soybean Association (Association américaine du soja), de National Association of Manufacturers of Edible Fats and Oils of Mexico (Association nationale des fabricants de graisses et d'huiles comestibles du Mexique), d'U.S. Agency for International Development (Agence américaine pour le développement international), de USDA Foreign Agricultural Service (Service d'agriculture à l'étranger du ministère de l'agricuture, USA), de USDA Science and Education Administration (Administration de science et d'éducation du ministère de l'agriculture, USA) et de l'état de Guerrero, Mexique. INTSOY est une organisation participante.

American Oil Chemists' Society, 508 S. Sixth Street, Champaign, Illinois 61801, USA, fournira de plus amples informations sur demande.

INTSOY est un programme de l'Université d'Illinois à Urbana-Champaign (E-U) et de l'Université de Puerto Rico, Campus de Mayaguëz, en coopération avec des organisations internationales et nationales dans le but de généraliser l'usage du soja pour l'alimentation humaine. INTSOY ne pratique de discrimination ni dans le domaine de l'emploi ni dans ses programmes. L'INTSOY Newsletter est partiellement subventionnée par l'Agence Américaine pour le Développement International (USAID); les points de vue et interprétations sont ceux de l'INTSOY et ne pourraient être attribués ni à USAID ni à aucune personne représentant cette organisation.

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INTSOY RESEARCH HIGHLIGHTS: SEED PATHOLOGY

In the tropics and subtropics, producers have difficulty obtaining good quality seed for planting. This problem affects the production of soybeans and other edible legumes. INTSOY pathologists, agronomists, and agricultural engineers at the University of Puerto Rico, Mayagüez Campus (UPR-MC), and at the University of Illinois at Urbana-Champaign (UIUC) have been investigating pathological factors that affect seed quality.

All soybean seeds are capable of carrying many kinds of microorganisms and viruses. Seedborne microorganisms include various fungi (molds) and bacteria, many of which can cause disease in soybean plants. Some of the important effects of these microorganisms are reductions in storage life, germination, emergence, vigor, and eventually yields.

The storage life of soybeans was studied under tropical conditions in Puerto Rico. Among the variables examined were initial seed moisture and quality, type of storage container, duration of storage, and seed dressing with a fungicide. We found that poor quality seed did not store as well as good quality seed. Viability was lost after 6 months if the seed was not kept in watertight containers. Treatment with a fungicide did not prevent loss of viability. Apparently, seedborne fungi were not entirely responsible for the loss.

Colonization by the bacterium *Bacillus subtilis* significantly increased with storage time, however. Found on soybean seeds collected from around the world, *B. subtilis* reduces seed quality in hot, humid weather.

INTSOY pathologists have defined the role of various microorganisms in reducing seed quality and how the environment affects the expression of symptoms. We have shown that several seedborne fungi reduce germination, emergence, and vigor of seedlings. Among the most important fungal pathogens and the problems they cause are: *Phomopsis* spp. (*Diaporthe phaseolorum* var. *sojae*), pod and stem blight and seed decay; *Colletotrichum dematium* var. *truncata,* anthracnose and seed discoloration; *Cercospora kikuchii,* leaf spotting and purple seed stain; and *Cercospora sojina,* frogeye leaf spot and pod spots. We used paraquat to detect latent colonization of leaves, stems, and pods by these fungi.

We found that most seedborne microorganisms initially colonize the various cell layers of the seed coat and then attack the embryo when the weather is hot and humid. *Phomopsis* spp. increased the number of moldy seeds and splits in a seed lot and reduced the test weight. Also, the quality of the oil and flour declined when many seeds were moldy. In cooperative studies with the Centro Internacional de Agricultura Tropical (CIAT), Colombia, we found that *Phaseolus* spp. bean seeds and the seeds of chickpea, pigeon pea, and cowpea were affected by the same fungi and in the same manner as soybean seeds.

The epidemiology of seed decay caused by *Phomopsis* spp. also was studied. A close correlation was found between the incidence of disease and rainfall during pod fill. This finding indicates that moisture, rather than temperature or geographic area, is dominant in the development of disease. A similar situation was found at J. Nehru Agricultural University, Jabalpur, India, during a study on planting dates using soybeans infected with *Colletotrichum dematium* var. *truncata.* Seeds harvested after the monsoon were of better quality and had fewer seedborne fungi than did seeds harvested during the monsoon. This finding suggests that soybean fields should be located in areas where dry conditions prevail during maturation of the seeds.

Whether grown in the field or in growth chambers, soybean plants inoculated with soybean mosaic virus were more susceptible to *Phomopsis* spp. than were noninoculated plants.

Species of *Colletotrichum* and *Phomopsis* were found on weeds associated with soybean fields in Illinois. In a study with the Universidade Federal de Vicosa, Brazil, a similar situation was found between weeds and soybeans at that location.

Studies of purple seed stain showed that natural infection by *Cercospora kikuchii* reduced the occurrence of *Fusarium* and *Phomopsis* spp. in Puerto Rico but not in Illinois. The percentages of seed infected with *C. kikuchii* have been found to be much greater in subtropical and tropical areas than in temperate regions.

Studies on the control of seedborne fungi have in-

cluded screening the tropical germplasm collection for resistance to seedborne fungi; using systemic fungicide sprays to reduce field infection by seedborne fungi; evaluating various traditional seed dressings; and infusing fungicides and antibiotics into seeds with acetone, dichloromethane, ethanol, polyethyleneglycol, and other solvents. The best seed treatment combines infusion with traditional dressing.

Through screening the tropical germplasm collection, we found 24 cultivars that are resistant to fungi carried within the seed. Some of these resistant cultivars were used in crosses in a breeding program. Begun by E. H. Paschal II and M. A. Ellis, this work is being continued by L. H. Camacho and P. R. Hepperly.

Preharvest fungicide sprays for controlling seedborne pathogens were first used at UIUC. Sprays are now recommended for soybean fields in the United States. Various fungicide solvent systems for reducing fungi after harvest were first described at UIUC and appear promising for use on breeders' seeds and on seeds in the germplasm collections.

At a Conference on Soybean Seed Quality and Stand Establishment to be held in Sri Lanka from January 25 to 31, 1981, we hope to identify the current state of knowledge on these subjects. We also want to define research needs in order to remove constraints and increase the production of good quality seed. Contact INTSOY for details of the Seed Quality and Stand Establishment Conference.

The research on seedborne fungal and bacterial diseases of soybean is coordinated by P. R. Hepperly, Department of Crop Protection, UPR-MC, and by J. B. Sinclair, Department of Plant Pathology, UIUC. More information is available from members of the team upon request.

SHORT COURSE OUTLOOK

Dates for the two soybean training courses offered by INTSOY in 1981 have been set. Technical and Economic Aspects of Soybean Production will be held May 18 to August 14. Soybean Processing for Food Uses will be held April 27 to June 12.

The training cost per participant, *not* including living expenses or international travel, is US$3,295 for the production course, and US$1,810 for the processing course. The suggested living allowance for the production course is US$3,000, and US$1,700 for the processing course. Additional information is available from J. W. Santas, INTSOY.

INTSOY STAFF RETURN

Two staff members have completed assignments for INTSOY country projects. A. G. Harms has returned to Illinois after serving as production economist for the Peru Soybean Project, supported by USAID. M. S. Chan returned to the United States after serving as food science specialist for the Sri Lanka Soybean Development Project, supported by UNDP, FAO, UNICEF, and CARE.

INTSOY is a program of the University of Illinois at Urbana-Champaign and the University of Puerto Rico, Mayagüez Campus, cooperating with international and national organizations to expand the use of soybeans for human food. INTSOY provides equal opportunities in programs and employment. The INTSOY Newsletter is partially supported by the U.S. Agency for International Development; the views and interpretations are those of INTSOY and should not be attributed to USAID or to any individual acting in their behalf.

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ASPECTOS DESTACADOS EN LAS INVESTIGACIONES DE INTSOY: PROGRAMA DE PATOLOGIA DE LA SEMILLA

En los trópicos y subtrópicos, los agricultores tienen dificultad en obtener semilla de buena calidad para la siembra. Este problema afecta la producción de soya y de otras leguminosas comestibles. Los patólogos, agrónomos e ingenieros agrícolas del programa de INTSOY de la Universidad de Puerto Rico, Recinto de Mayagüez (UPR-MC) y de la Universidad de Illinois en Urbana-Champaign (UIUC) han estado investigando los factores patológicos que afectan la calidad de la semilla.

La semilla de soya puede ser portadora de muchos microorganismos y virus. Estos microorganismos en la semilla incluyen varias clases de hongos y bacteria muchos de los cuales pueden causar enfermedades en las plantas de soya. Algunos de los efectos causados por estos microorganismos son reducción del período de almacenaje de la semilla, reducción de la germinación, brote y vigor de las plantulas y, eventualmente, reducción del rendimiento en la cosecha.

Estudios para determinar la duración del período de almacenaje de la semilla de soya bajo condiciones tropicales fueron realizados en la Universidad de Puerto Rico. Se evaluaron los siguientes factores: la humedad de la semilla y su calidad al iniciarse el almacenaje, el tipo de recipiente usado, el período de almacenaje y el uso de fungicidas. Econtramos que en almacenaje, la semilla de calidad inferior se deteriora más rápidamente que la de buena calidad. La viabilidad de la semilla se perdió a los 6 meses cuando ésta no se mantuvo en recipientes a prueba de humedad. El uso de fungicidas no evitó que la semilla perdiera su viabilidad. Aparentemente, la pérdida de viabilidad no se debió exclusivamente a la presencia de hongos portados en la semilla.

Sin embargo, se encontró que la colonización de la bacteria *Bacillus subtilis* en la semilla aumentaba en almacenaje. La bacteria *B. subtilis,* que se ha encontrado en semillas provenientes de todas partes del mundo, deteriora la semilla en climas cálidos y húmedos.

Los patólogos de INTSOY han definido el papel que varios microorganismos juegan en el deterioro de la calidad de la semilla, como también los efectos del ambiente en la expresión de síntomas. Ya hemos mostrado que varios microorganismos portados por la semilla reducen la germinación, brote y vigor en las plantulas. Entre los hongos patógenos más importantes y los problemas que causan se encuentran: *Phomopsis* spp. (*Diaporthe phaseolorum* var. *sojae*), tizón de la vaina y del tallo y deterioro de la semilla; *Colletotrichum dematium* var. *truncata,* antracnosis y decoloración de la semilla; *Cercospora kikuchii,* mancha de la hoja y mancha púrpura en la semilla; y *Cercospora sojina,* mancha "ojo de rana" de la hoja y mancha de la vaina. Usamos herbicida paraquat para facilitar la detección de colonización latente de estos hongos en hojas, tallos y vainas.

Encontramos que la mayoría de los microorganismos portados en la semilla colonizan inicialmente varias capas de células en la cutícula de la semilla y entonces proceden a atacar al embrión cuando el clima es caliente y húmedo. La especie *Phomopsis* spp. aumentó el número de semillas con hongos, la cantidad de rajaduras en un lote de semillas y su peso de prueba. Además, la calidad del aceite y de la harina rebajó cuando muchas de las semillas tenían hongos. En trabajos realizados en cooperación con el Centro Internacional de Agricultura Tropical (CIAT), Colombia, hallamos que el frijol (*Phaseolus* spp.), garbanzo, gandul (*Cajanus cajan*) y caupí (*Vigna* spp.) son afectados por los mismos hongos y de igual manera que la soya.

También se estudio la epidemiología del deterioro de la semilla por *Phomopsis* spp. Se encontró una gran correlación entre la incidencia de la enfermedad y la precipitación pluvial durante el período en que se llenan las vainas. Este hallazgo indica que es la humedad, y no la temperatura o área geográfica, lo que constituye el factor dominante en el desarrollo de la enfermedad. Se encontró una situación similar en la Universidad de Agricultura J. Nehru en Jabalpur, India, mientras se estudiaban las épocas de siembra usando semilla de soya infectada con *Colletotrichum dematium* var. *truncata.* Las semillas cosechadas después del monsón eran de mejor calidad y portaban menos hongos que las cosechadas durante el monsón. Esto sugiere que la soya debe cultivarse en áreas en que las condiciones secas prevalezcan durante la maduración de la semilla.

Las plantas de soya inoculadas con virus de mosaico (SMV), sean éstas cultivadas en el campo o en cámaras de crecimiento, fueron más susceptibles a *Phomopsis* spp. que las plantas no inoculadas.

Especies de *Colletotrichum* y *Phomopsis* fueron encontradas en yerbajos asociados con plantíos de soya en Illinois. En estudios en cooperación con la Uni-

versidad Federal de Vicosa, Brasil, se encontró también una situación similar en yerbajos y soya en esa localidad.

Las investigaciones sobre la mancha púrpura de la semilla demostraron que la infección natural de *Cercospora kikuchii* redujo la ocurrencia de *Fusarium* y *Phomopsis* spp. en Puerto Rico pero no en Illinois. El porcentaje de semilla infectada con *C. kikuchii* es mayor en áreas subtropicales y tropicales que en áreas templadas.

Los estudios sobre el control de hongos portados en la semilla han incluído la selección en la colección de germoplasma tropical para resistencia a los hongos en la semilla; el uso de asperciones foliares con fungicidas sistémicos para reducir la infección por hongos en la semilla en los plantíos; la evaluación de tratamientos tradicionales de la semilla; y la infusión de la semilla con fungicidas y antibióticos usando acetona, diclorometano, étanol, glicol de polietileno y otros solventes. El mejor tratamiento es una combinación del método de infusión con el tratamiento tradicional.

A través de la selección del germoplasma tropical, identificamos 24 cultivares resistentes a hongos portados en la semilla. Algunos de estos cultivares resistentes fueron usados en cruces genéticos en un programa de fitomejoramiento. Dichos trabajos fueron iniciados por E. H. Paschal II y M. A. Ellis y en la actualidad están a cargo de L. H. Camacho y P. R. Hepperly.

Las aspersiones con fungicidas, previas a la cosecha, para controlar los patógenos portados en la semilla fueron usadas por primera vez en la UIUC. Estas aspersiones ahora son parte de las recomendaciones del cultivo de soya en los Estados Unidos. Varios sistemas de fungicidas solventes para reducir los hongos después de la cosecha fueron descritos por primera vez por la UIUC y se muestran prometedores para usarse en semilla para programas de fitomejoramiento y para el mantenimiento de semilla en colecciones de germoplasma.

Del 25 al 31 de enero de 1981 se celebrará en Sri Lanka el Congreso Sobre Calidades de Semilla y Establecimiento de Plantíos de Soya en el que esperamos identificar el estado actual del conocimiento en la materia. También pretendemos determinar las necesidades de investigación cientifica para poder eliminar las limitaciones y aumentar la producción de semilla de buena calidad. Para obtener información adicional sobre el congreso sírvase dirigirse a INTSOY.

La investigación relacionada con hongos y bacteria portadas en la semilla de soya es coordinada en Puerto Rico por P. R. Hepperly, Departamento de Protección de Cultivos, UPR-MC, y por J. B. Sinclair, Departamento de Fitopatología, UIUC. Para información más detallada al respecto, favor dirigirse a cualquier miembro del programa.

CURSOS CORTOS DE INTSOY

Se han fijado ya las fechas para los cursos de entrenamiento sobre soya a ofrecerse por INTSOY en 1981. El curso de Aspectos Técnicos y Económicos de la Producción de Soya tendrá lugar del 18 de mayo al 14 de agosto. El curso sobre Procesamiento de la Soya para Usos Alimenticios se llevará a cabo del 27 de abril al 12 de junio.

El costo de entrenamiento por participante, *sin* incluir los gastos de alojamiento y alimentación *ni* los costos de transporte internacional, es de US$3.295 para el curso de producción, y de US$1.810 para el de procesamiento. Los gastos de alojamiento y alimentación para el curso de producción se han estimado en US$3.000 y US$1.700 para el de procesamiento. Para obtener información en detalle pueden dirigirse a J. W. Santas, INTSOY.

REGRESAN MIEMBROS DEL PROGRAMA DE INTSOY

Dos miembros del Programa de INTSOY han completado sus asignaciones en el exterior. A. G. Harms ha regresado a Illinois después de servir como economista de producción en el Programa de Soya en Perú, patrocinado por USAID. M. S. Chan ha vuelto a los Estados Unidos después de servir como especialista en la ciencia de alimentos en el Programa de Desarrollo de la Soya en Sri Lanka, que patrocinan la UNDP, FAO, UNICEF y CARE.

INTSOY es un programa de la Universidad de Illinois, en Urbana-Champaign, y la Universidad de Puerto Rico, Recinto de Mayagüez, que coopera con organizaciones nacionales e internacionales a fin de propagar el uso de la soya para la alimentación humana. INTSOY proporciona igualdad de oportunidades en programas y empleos. INTSOY Newsletter está subvencionado en parte por la Agencia para el Desarrollo Internacional de los Estados Unidos (USAID). Los puntos de vista y las interpretaciones que aparecen en este Newsletter son exclusivos de INTSOY y no se deben atribuir a USAID ni a ninguna otra agencia o persona que actúe en su nombre.

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POINTS CULMINANTS DE LA RECHERCHE INTSOY: PATHOLOGIE DES SEMENCES

Dans les régions tropicales et subtropicales, les producteurs éprouvent des difficultés pour l'obtention de semences de plantation de bonne qualité. Ce problème concerne la production de soja et autres légumes comestibles. Les pathologistes, agronomes et ingénieurs agronomes d'INTSOY à l'Université de Porto Rico, Campus de Mayagüez (UPR-MC), et à l'Université d'Illinois à Urbana-Champaign (UIUC) ont étudié les facteurs pathologiques affectant la qualité des semences.

Toutes les semences de soja peuvent être porteuses de quantités de microorganismes et de virus. Les microorganismes portés par les semences comprennent divers champignons (moisissures) et bactéries dont plusieurs peuvent causer des maladies dans les plants de soja. Parmi les effets importants de ces microorganismes on peut citer: une réduction de la durée de stockage, de germination, d'émergence, de vigueur et éventuellement de rendement.

C'est dans des conditions de climat tropical que l'on a étudié la durée de stockage du soja à Porto Rico. Parmi les variables étudiés figurent: l'humidité initiale et la qualité des semences, le genre de conteneur de stockage, la durée du stockage et le traitement des semences à l'aide d'un fongicide. On a remarqué que des semences de qualité inférieure ne se stockaient pas aussi bien que des semences de bonne qualité. Si les semences n'étaient pas conservées dans des conteneurs imperméables à l'eau, la viabilité ne durait que 6 mois. Le traitement à l'aide d'un fongicide n'entravait aucunement la perte de viabilité. Apparemment, les champignons portés par les semences n'étaient pas entièrement responsables de la perte.

Toutefois, la colonisation par la bactérie *Bacillus subtilis* s'est singulièrement accrue selon la durée de stockage. La *B. subtilis* trouvée sur des semences de soja récoltées dans le monde entier réduit la qualité des semences par temps très chaud et humide.

Les pathologistes d'INTSOY ont défini le rôle de divers microorganismes réduisant la qualité des semences et observé comment le milieu agit sur l'expression des symptômes. Nous avons montré que plusieurs champignons portés par les semences réduisent la germination, l'émergence et la vigueur des jeunes plants. Parmi les pathogènes fongueux les plus importants et les problèmes qu'ils causent, nous citons: le *Phomopsis* spp. (*Diaporthe phaseolorum* var. *sojae*), la nielle des gousses et des tiges et le dépérissement des semences; le *Colletotrichum dematium* var. *truncata,* anthracnose et décoloration des semences; la *Cercospora kikuchii,* tachetures des feuilles et taches pourpres des semences; et la *Cercospora sojina,* la *Cercospora* sous forme de tachetures des feuilles et des gousses. Nous avons utilisé le paraquat pour détecter la colonisation latente des feuilles, des tiges et des gousses par ces champignons.

Nous avons vu que la plupart des microorganismes portés par les semences colonisent initialement les diverses couches de cellules de l'enveloppe des semences et attaquent ensuite l'embryon lorsque le temps est très chaud et humide. Le *Phomopsis* spp. augmentait la quantité de semences moisies ainsi que le nombre d'éclatements dans un lot de semences et réduisait le poids témoin. De même, la qualité de l'huile et de la farine déclinait lorsque beaucoup de semences étaient moisies. A l'aide d'études faites en coopération avec le Centro Internacional de Agricultura Tropical (CIAT), en Colombie, nous avons vu que les semences de haricots du type *Phaseolus* spp. et les semences de pois chiches, de pois de pigeons et de pois sauvages étaient atteintes par les mêmes champignons et de la même manière que les semences de soja.

L'épidémiologie de la décomposition des semences causée par le *Phomopsis* spp. a également été étudiée. On a remarqué une corrélation étroite entre l'incidence de la maladie et des pluies pendant l'emplissage des gousses. Cette découverte montre que c'est l'humidité plutôt que la température ou la situation géographique qui est prépondérante dans l'évolution de la maladie. On a connu un fait semblable à l'Université Agricole J. Nehru à Jabalpur, en Inde, au cours d'une étude sur les dates de plantation, utilisant du soja contaminé par le *Colletotrichum dematium* var. *truncata.* Les semences récoltées après la mousson étaient de meilleure qualité et avaient moins de champigons portés par les semences que les semences récoltées pendant la mousson. Cette découverte suggère que les champs de soja devraient se trouver dans des endroits généralement secs pendant la maturation des semences.

Qu'ils poussent dans des champs ou dans des locaux artificiels de croissance, les plants de soja

inoculés avec un virus de la mosaïque du soja sont plus sensibles au *Phomopsis* spp. que les plants non-inoculés.

On a trouvé des espèces de *Colletotrichum* et de *Phomopsis* sur des mauvaises herbes poussant dans des champs de soja dans l'Illinois. Dans une étude avec l'Universidade Federal de Vicosa au Brésil, on a trouvé une situation semblable entre mauvaises herbes et soja à cet endroit.

Des études sur les taches pourpres du soja ont montré que la contamination naturelle par la *Cercospora kikuchii* réduisait la possibilité de *Fusarium* et de *Phomopsis* spp. à Porto Rico, mais pas dans l'Illinois. On a vu que les pourcentages de semences contaminées par la *C. kikuchii* étaient bien plus élevés dans des régions subtropicales et tropicales que dans régions tempéreés.

Des études sur le contrôle des champignons portés par les semences comprennent le sassement de la récolte de plasma germatif pour la résistance aux champignons portés par les semences; l'utilisation systématique de vaporisations de fongicides pour réduire la contamination du champ par les champignons portés par les semences; l'évaluation de divers traitements de semences traditionnels; et l'infusion de fongicides et d'antibiotiques dans les semences avec de l'acétone, du dichlorométhane, de l'éthanol, du polyéthylèneglycol et autres solvants. Le meilleur traitement des semences allie l'infusion au traitement traditionnel.

En procédant au sassement de la récolte de plasma germatif tropical on a trouvé 24 cultivars résistant aux champignons portés au sein des semences. Quelques-uns de ces cultivars résistants ont été utilisés dans des croisements dans un programme de reproduction. Commencé par E. H. Paschal II et M. A. Ellis, ce travail est poursuivi par L. H. Camacho et P. R. Hepperly.

C'est à UIUC que les premières vaporisations de fongicides avant la récolte ont été utilisées pour le contrôle des pathogènes portés par les semences. Les vaporisations sont actuellement conseillées pour les champs de soja aux Etats-Unis. Divers systèmes de solvants fongicides pour la réduction des champignons après la récolte ont été décrits en premier lieu à UIUC et semblent prometteurs pour l'utilisation sur des semences de reproduction et sur des semences pour la récolte de plasma germatif.

Lors de la conférence sur la qualité des semences du soja et l'implantation des plants qui se tiendra à Sri Lanka du 25 au 31 janvier 1981, nous espérons identifier l'état actuel de la recherche sur ces sujets. Nous voudrions également définir les besoins de la recherche en vue d'éliminer les contraintes et d'augmenter la production des semences de bonne qualité. Pirère de contacter INTSOY pour les détails concernant la conférence sur la qualité des semences et l'implantation des plants.

La recherche sur les champignons portés par les semences et les maladies bactériennes du soja est faite conjointement par P. R. Hepperly, Department of Crop Protection, UPR-MC, et par J. B. Sinclair, Department of Plant Pathology, UIUC. Les membres de l'équipe fournissent tous renseignements complémentaires sur demande.

COUP D'OEIL SUR LES MINI-COURS

Les dates pour les deux cours de formation pratique sur le soja organisés par INTSOY ont été choisies. Les aspects techniques et économiques de la production du soja seront traités du 18 mai au 4 août. Les processus de transformation du soja pour les besoins de l'alimentation seront traités du 27 avril au 12 juin.

Les frais de formation pratique par participant — frais de séjour ou frais de déplacements internationaux *non* compris — s'élèvent à US$3.295 pour le cours sur la production et à US$1.810 pour le cours sur les processus de transformation. Les frais de séjour pour le cours sur la production ont été estimés à US$3.000 et à US$1.700 pour le cours sur les processus de transformation. Pour tous renseignements complémentaires, s'adresser à J. W. Santas, INTSOY.

RETOUR DU PERSONNEL INTSOY

Deux membres d'INTSOY ont terminé leur mission pour des projets outre-mer. A. G. Harms est revenu dans l'Illinois après avoir rempli les fonctions d'économiste de la production pour le projet péruvien pour le soja, avec l'aide d'une subvention USAID. M. S. Chan est revenu aux Etats-Unis après avoir assumé les fonctions de spécialiste en science alimentaire pour le projet de développement du soja à Sri Lanka, subventionné par UNDP, FAO, UNICEF et CARE.

INTSOY est un programme de l'Université d'Illinois à Urbana-Champaign (E-U) et de l'Université de Puerto Rico, Campus de Mayaguëz, en coopération avec des organisations internationales et nationales dans le but de généraliser l'usage du soja pour l'alimentation humaine. INTSOY ne pratique de discrimination ni dans le domaine de l'emploi ni dans ses programmes. L'INTSOY Newsletter est partiellement subventionnée par l'Agence Américaine pour le Développement International (USAID); les points de vue et interprétations sont ceux de l'INTSOY et ne pourraient être attribués ni à USAID ni à aucune personne représentant cette organisation.

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INTSOY RESEARCH HIGHLIGHTS:
WEED CONTROL IN THE TROPICS

One of INTSOY's primary goals is to promote soybean cultivation among small-scale farmers in the tropics. Weeds hinder soybean production throughout the world, but losses due to weeds are greatest under tropical conditions. Until recently, most weed control studies have been conducted in temperate zones for large-scale farmers. To help supply needed information, INTSOY is investigating the control of weeds among soybean in Puerto Rico. In a relatively small area, Puerto Rico offers a variety of tropical climates, soils, and weed species. These conditions have permitted simultaneous testing of control methods under widely differing environments.

The use of chemical control on small-scale farms in the tropics is limited because herbicides are seldom available, they are expensive, and few farmers know how to apply them. We are therefore investigating agronomic practices that small-scale farmers might adopt to reduce yield losses due to weeds. For those farmers who use herbicides, we have conducted tests to determine which treatments are best suited to specific and general situations.

The majority of small-scale farmers in the tropics control weeds by hand. A. G. Harms, INTSOY agricultural economist working in Peru, found that hand weeding was the biggest production input on small soybean farms. But if farmers are unaware of the critical periods of weed competition, weeding may be ill-timed and cause more harm than good. For this reason we have undertaken a major study to determine the critical periods of weed competition in tropical soybean and the effects of varieties and planting dates.

Results indicate that yield losses from weeds are greatest during the period of rapid soybean growth, three to five weeks after crop emergence. Losses ranged from 70 to 90 percent during the rainy season, when conditions favor weed growth, and from 15 to 20 percent during the dry season. Increased weed growth during the rainy season requires more frequent weeding to prevent stress from weeds during this period.

Soybean cultivars vary in their period of rapid growth, thus influencing the critical period of weed competition. For example, varieties that grow rapidly early in the season need early weeding.

Photoperiod greatly affects the period of soybean vegetative growth. When this growth is reduced by a short photoperiod, as in late plantings or at low latitudes, the critical period of weed competition starts soon after the plant emerges.

Farmers with serious weed problems may want to try varieties whose yields are not greatly reduced by weeds. When the yields of eight soybean varieties were compared between weeded and unweeded plots, losses of less than 20 percent to more than 45 percent were recorded.

Row widths of 30, 45, and 60 cm were tested for their effect on yields and weed development. For Williams and other varieties with restricted vegetative development, the yield was significantly greater at 30 than at 60 cm with weed control. For Jupiter, a variety that is taller and has more vegetative development, the biggest yield was obtained at 45 cm with weed control. Without control, yield reductions were greatest at 60 cm for both Williams and Jupiter. Thus, the narrower row width can be recommended for small-scale farmers.

Herbicides were tested extensively in areas of Puerto Rico where the soils represent the three major groups encountered in the tropics. In oxisols the predominant weed was wild poinsettia (*Euphorbia heterophylla*); in vertisols, johnsongrass (*Sorghum halepense*); and in mollisols, horse purslane (*Trianthema portulacastrum*). Morningglory (*Ipomoea* sp.), one of the most difficult weeds to control in soybean, was abundant at all three sites. Besides depressing yields by competition, morningglory interferes with harvesting. The common annual grasses were junglerice (*Echinochloa colonum*), goosegrass (*Eleusine indica*), and large crabgrass (*Digitaria sanguinalis*).

Preplant incorporated herbicides that have performed well are EPTC, fluchloralin, pendimethalin, profluralin, trifluralin, and vernolate. Preemergence herbicides that have been effective in a number of situations are alachlor, chloramben, DCPA, diphenamid, linuron, metolachlor, metribuzin, oxadiazon, oxifluorfen, prometryne, and thiobencarb. Postemergence compounds that are selective for soybean are not readily available. Bentazon, chloroxuron, and the more recently developed acifluorfen have been tested. Acifluorfen, the most active of the three, provides good control of several broadleaf weeds including morningglory.

In most situations, no single product can control all the weed species present. To broaden the spectrum and at the same time reduce the risk of crop injury,

it is advisable to combine herbicides. Combinations of 0.5 kg/h of metribuzin with some of the preplant incorporated or preemergence herbicides often give better and more selective control than any product used alone.

Persistence of preemergence herbicides is important for varieties having a relatively long period of slow growth. To optimize the yields of these cultivars, preemergence herbicides should be combined with one mechanical weeding before the critical period.

Glyphosate was tested as a preplant treatment for johnsongrass on tilled and untilled plots. Yields were better on the untilled plots treated with glyphosate and a combination of 0.5 kg/h of metribuzin plus 1.5 kg/h of alachlor. Directed postemergence applications of glyphosate by spraying or other methods have also provided effective control of johnsongrass.

In summary, small-scale farmers can greatly decrease the losses due to weeds by planting a competition-tolerant variety in row widths of 45 cm or less and by weeding between the third and fourth week of soybean growth. If available, the recommended herbicides may be used, but the decision should be based on cost, soil type, weed species, and prevalent climatic conditions.

For more information on INTSOY's weed science research program, write to Dr. Guillermo Riveros, Department of Agronomy, University of Puerto Rico, Mayagüez, Puerto Rico 00708, USA.

SOYBEAN COURSE IN COLOMBIA

Twenty-eight participants from ten Latin American countries attended the Soybean Production Course held in Palmira and the Cauca Valley of Colombia from November 24 to December 12, 1980. The course was sponsored jointly by the Instituto Colombiano Agropecuario and INTSOY. This was the second year that the course was offered for Spanish-speaking personnel in research, extension, and production.

INTSOY TELEX NUMBER

The INTSOY office at the University of Illinois can now be contacted by Telex. The Telex number is 206957. The answerback code is INTAG URBA.

SEARCH FOR NEW INTSOY DIRECTOR

Applications for the position of INTSOY Director will be accepted until April 15, 1981, or until a qualified person is found.

The Director is responsible for the administration of the program, coordination of research, budget development including identification of funding sources, international projects, training, conferences, and publications. The Director is also responsible for liaisons with all cooperating and sponsoring organizations.

Applicants should hold a Ph.D. or equivalent degree in an agricultural field. They should have at least ten years' experience in their field and a strong background in international activities. Applicants must read, write, and speak English fluently. A working knowledge of one other language is desirable.

To apply, send INTSOY a statement of professional qualifications, work experience, university credentials, and a list of publications. In addition, have three letters of recommendation sent to: INTSOY, 113 Mumford Hall, 1301 W. Gregory Drive, Urbana, IL 61801, USA.

The University of Illinois is an equal opportunity employer.

INTSOY is a program of the University of Illinois at Urbana-Champaign and the University of Puerto Rico, Mayagüez Campus, cooperating with international and national organizations to expand the use of soybeans for human food. INTSOY provides equal opportunities in programs and employment. The INTSOY Newsletter is partially supported by the U.S. Agency for International Development; the views and interpretations are those of INTSOY and should not be attributed to USAID or to any individual acting in their behalf.

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NO. 25, MAY 1981

INTSOY RESEARCH HIGHLIGHTS: SOYBEAN UTILIZATION

Soybeans are a very economical source of major nutrients. Even in areas of the world where yields are small, soybeans produce from two to five times more protein per hectare than do other common field crops; soybeans contain about 40 percent protein and 20 percent oil.

As part of its program INTSOY continues to develop practical methods for utilizing soybeans in the human diet. This Newsletter contains a summary of research at the University of Illinois at Urbana-Champaign and INTSOY-assisted programs in Sri Lanka and Peru.

University of Illinois. Scientists in the Department of Food Science have developed processing methods that can be used commercially and in the home for making many products from whole soybeans. Field-dried soybeans are carefully cleaned to remove foreign material and damaged or moldy beans. The beans are then soaked and blanched. The blandness of soybeans processed in this way results from the inactivation of enzymes, which prevents a bitter or painty flavor.

Properly hydrated and blanched soybeans can be used to make a wide variety of products, including drum-dried flakes, canned soybeans, dairy product analogs, and snack foods.

Sri Lanka. INTSOY is assisting with the research and education activities of the Sri Lanka Soybean Development Project. This work is done in collaboration with the Government of Sri Lanka and several of its agricultural organizations. Support is provided by the United Nations Development Program (UNDP), the Food and Agriculture Organization of the United Nations (FAO), the United Nations Children Fund (UNICEF), and CARE.

CARE and UNICEF provided funds to equip the Soybean Foods Research Center, a pilot food-processing plant and training facility designed by Professor A. I. Nelson, INTSOY consultant from the University of Illinois. To help promote commercial production, the center produces many soy foods for sale to private firms. Sales of drum-dried soy beverage and full-fat soy flour average 4,550 kg per month.

The plant also produces a fortified infant weaning ıll-fat flour, rice, and mung beans. Currently, the cost of imported weaning foods is US$5.50 per kg; estimated retail price of the new product is US$1.50. Other products include pasteurized soy beverage and a high protein soy-corn mixture that can be substituted for dhal. Private industry and the government will produce these foods in the near future. Also being researched are tofu, tempeh, soy yogurt, and soy ice cream.

The development and dissemination of village-level technology is an important part of the soybean utilization program. In a facility adjacent to the pilot plant, extension workers and village leaders are taught to use soybeans in traditional dishes. Forty recipes containing 25 to 50 percent whole soybeans, soy flour, or soy beverage have been developed. Only the type of equipment available in homes and villages is used. Outfitted with 21 cooking units, the facility can accommodate 30 trainees at a time. During the past two years, 1,400 people have been trained in courses lasting one to two weeks. Project personnel work closely with the Farm Women's Agricultural Extension Programs of the Sri Lanka Department of Agriculture.

The 2,000 hectares of soybeans grown annually in Sri Lanka could be expanded to 20,000 hectares as the demand increases. The future of soybean production in Sri Lanka depends on the acceptance of soy foods into the diet. Prospects for the future are bright.

Peru. For the past three years, the Instituto Nacional de Desarrollo Agro-Industrial (INDA) in Lima has sponsored a project that is concentrating on product identification and development of soy foods. The project is part of a large collaborative program between the Peruvian Ministry of Agriculture and Food and the United States Agency for International Development (USAID).

INTSOY is working with industry toward the commercial introduction of three soybean products: a beverage in both liquid and powdered form, soy-fortified bread, and soy-fortified noodles. Technical advice and assistance are given to companies that have an interest in processing soy food products.

A process using simple equipment available locally was developed for preparing liquid and powdered

soy beverage. Now being produced and marketed by local food companies, the beverage has wide distribution in Peru.

Efforts have been concentrated on preparing full-fat soy flour from whole, dehulled soybeans. Produced by a local cereal processing company, soy flour is used as a partial substitute for wheat flour to enrich bread and pasta. Soy fortification of popular food products increases both the quality and quantity of protein in the local diet.

Lectures and courses are given in rural and urban areas to demonstrate the preparation of soybeans in the home. Simple, basic recipes are used, and participants are taught how to prepare a soy beverage from whole soybeans and from full-fat flour. In 1979 a Spanish-language cookbook was published with 80 recipes based on whole soybeans, soybean cake, and soy flour. Several leaflets containing recipes with soy ingredients have also been distributed. Hospital, ministry and other governmental personnel, as well as private groups, attend the courses and lectures.

The increase in commercial soybean processing is a positive sign that people are accepting soybeans and recognizing their importance in the diet. Simple processing methods and the use of soybeans in popular foods can significantly improve the nutritional well-being of people in Peru and other nations.

SEED QUALITY CONFERENCE A SUCCESS

A conference on Soybean Seed Quality and Stand Establishment was held in Colombo, Sri Lanka, from January 25 to 31, 1981. The conference was sponsored by the Sri Lanka Ministry of Agricultural Development and Research, the Seed Technology Laboratory at Mississippi State University, USA, and INTSOY, in collaboration with the Food and Agriculture Organization of the United Nations (FAO) and the U.S. Agency for International Development (USAID).

There were 74 registrants from 22 countries in Africa, Asia, the Caribbean, Europe, and Latin America. Four international organizations were represented. Proceedings of the conference will be published as part of the INTSOY publication series. An announcement will appear in the INTSOY Newsletter as soon as the proceedings are available.

W. H. JUDY TO WASHINGTON, D.C.

William H. Judy, INTSOY agronomist and coordinator of the variety improvement program, has accepted a position with the Africa Bureau of USAID/Washington, D.C. ISVEX, SIEVE, and SPOT cooperators should now communicate with Dr. Joseph A. Jackobs, Department of Agronomy, AW-110 Turner Hall, 1102 South Goodwin Avenue, Urbana, IL 61801 USA.

INTSOY TELEX NUMBER

INTSOY can now be contacted by Telex. The Telex number is 206957. The answerback code is INTAG URBA.

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NO. 26, AUGUST 1981

INTSOY RESEARCH HIGHLIGHTS: SOIL MICROBIOLOGY PROGRAM

Soybean inoculants and their survival pose many problems in the tropics. For successful nodulation, adequate numbers of *Rhizobium japonicum* must survive in the soil. In the tropics and subtropics, however, stress factors such as high soil temperatures, low soil moisture, and acidic soils interfere with nodulation. Insufficient nodulation causes a deficiency in plant nitrogen and thus a yield reduction. The INTSOY soil microbiology program is investigating problems related to fostering a dynamic association between *R. japonicum* and soybeans under tropical conditions.

International trials. Two new trials, IISE and ISRIE, were created as part of the INTSOY microbiology program. IISE, the International Inoculant Shipping Evaluation, measured the quality of granular soybean inoculant after samples were shipped to 156 cooperators in the tropics and subtropics. Each sample initially had a moisture content of 35 percent and contained 1×10^9 (1 billion) cells per gram of inoculant. A label with four temperatures (38°, 43°, 49°, 54°C), each in a separate circle, was attached to every sample. As the temperature increased, the appropriate circle turned irreversibly black.

Forty-eight percent of the samples showed no temperature change; 36 percent exceeded the lowest labeled temperature, 7 percent the second, 8 percent the third, and 1 percent the highest. Viable *Rhizobium* numbers declined as the temperature increased and moisture content decreased. Longer shipping times also lowered the number of viable *Rhizobium* because of natural decay and the drop in moisture content. An exponential curve describes the relationship between days in transit and the number of viable *Rhizobium* cells, ranging from 2×10^6 (2 million) to 1.4×10^8 (140 million) cells per gram of inoculant. The same type of curve also describes the relationship between viable cells and the final moisture content, ranging from 12.4 to 33.4 percent.

ISRIE, the International Soybean Rhizobium Inoculant Experiment, is offered as a supplement to ISVEX cooperators. (ISVEX is the International Soybean Variety Experiment.) The purpose of ISRIE is to determine the yield response of soybeans inoculated with *R. japonicum,* to evaluate the granular method of inoculation, and to assist in interpreting the nodulation data obtained from ISVEX. Data from ISRIE are still being collected from the 107 trials sent out to 62 cooperators in 47 countries.

Survival experiments. The current scientific literature indicates that highly acidic soils due to aluminum concentrations are toxic to *R. japonicum.* An experiment conducted at the Corozal Agricultural Experiment Station in Puerto Rico does not support this finding. Lee, a soybean variety sensitive to aluminum, and Davis, a tolerant variety, were grown for two seasons with normal soil treatments of phosphorus (P) and potassium (K) and from zero to two times the amount of lime necessary to neutralize the aluminum. Nitragin, an inoculant prepared by the Nitragin Company in the United States, was used at the recommended rates on all plots except the controls. Nodulation for all of the plots was good. In tests to determine which of the four strains of *R. japonicum* in Nitragin caused nodule formation, we found that one strain produced 83 percent of the nodules.

The same field was planted the next year with Lee and Davis soybeans. No amendments were added to the soil, which had a pH of 4.7 to 6.8. Nodulation was fair to good.

In 1980 a study was begun to compare the survival of eight strains of *Rhizobium* in soils with high levels of aluminum. These soils had a natural pH of 4.5 and an augmented pH of 6.5. Nodulation for all the inoculated plots was good. With lime added, the control plots yielded 1,886 kg/ha, while the plots treated with *Rhizobium* averaged 2,116 kg. Without lime, the control plots yielded 1,752 kg/ha, and the *Rhizobium*-treated plots averaged 1,996 kg.

Enhancing nodulation and plant growth. In greenhouse experiments, we attempted to enhance nodulation and plant growth through the interaction of *Azotobacter* and *R. japonicum. Azotobacter* is a nonsymbiotic bacterium that fixes nitrogen in the soil. Various amounts of *A. beijerinckii* and *A. chroococcum* were individually mixed with two strains of *R. japonicum.* One strain produced significantly greater dry shoot and nodule weights with *A. beijerinckii* and *A. chroococcum* than did the control or the strain

alone. The second strain of *R. japonicum* did not show any interaction with either species of *Azotobacter.*

Stem elongation. Under tropical conditions, soybean varieties developed for temperate regions have a reduced vegetative growth stage. The stems are short, and pods grow close to the ground. Consequently, mechanical harvesting is difficult. Gibberellic acid (GA_3) is known to produce stem elongation in soybeans. According to the literature, as much as 100 μg/ml of GA_3 can be added to the *Rhizobium* inoculant without affecting nodulation.

To determine varietal response to GA_3, the seeds of four soybean varieties were soaked in concentrations ranging from zero to 500 μg/ml and then transferred to trays filled with sterile gravel. The response among all varieties when compared with the controls was positive, but with considerable variability due to the interaction between concentration and variety. In all varieties, however, germination was completely inhibited by a concentration of 500 μg/ml.

The future. INTSOY soil microbiology will continue to investigate methods of enhancing the survival of *Rhizobium* in peat and other carriers and to study the association between *Rhizobium* and *Azotobacter.* We plan to develop a simple method of growing *Rhizobium* cultures under nonlaboratory conditions. Many other projects are also under way or are planned for the near future. For more information write to Dr. W. C. Stearn, INTSOY/Microbiology, College of Agricultural Sciences, University of Puerto Rico, Mayagüez, Puerto Rico 00708 USA. Dr. Stearn's telephone number is (809) 832-3980.

SOYBEAN SHORT COURSE COMPLETED

Eight participants recently received certificates after completing the INTSOY-sponsored training course, Technical and Economic Aspects of Soybean Production: W. M. S. Bowatte, Sri Lanka; Paulo Galerani, Brazil; Hajijulla Hadurulla, Philippines; Faustino Hidalgo, Peru; Fathi M. Kahalifa, Sudan; Juju Manandhar, Nepal; Nkusu Miasuekama, Zaire; and Frankie J. M. Sung, Taiwan. This is the seventh year that the course was offered. John W. Santas, INTSOY, was technical leader.

SHORT COURSE OUTLOOK

Dates have been set for the two training courses to be offered by INTSOY in 1982. Technical and Economic Aspects of Soybean Production will be held May 17 to August 6. Soybean Processing for Food Uses will be held May 17 to July 3.

The estimated training fee is US$3,500 for the production course, and US$1,900 for the processing course. International travel and living expenses are not included in this fee. The suggested living allowance for the production course is US$3,200 and US $1,800 for the processing course.

INTSOY does not provide scholarships. In the past, sponsors have included employers, governments, and international agencies such as FAO and USAID. All enrollees are expected to understand, read, write, and speak English. Additional information is available from John W. Santas, INTSOY.

INTSOY MAILING LIST

We are still updating the mailing list. If you have not yet sent us your current mailing address, please do so as soon as possible.

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NO. 27, NOVEMBER 1981

INTSOY RESEARCH HIGHLIGHTS: SOYBEAN RUST

Rust is a major constraint to soybean production in tropical and subtropical areas of the eastern hemisphere. The disease also threatens production in the western hemisphere. All commercial soybean cultivars are susceptible to soybean rust in the Americas and the Caribbean, where the growing conditions favor rust development. The disease has been reported on soybeans in Brazil, Colombia, Costa Rica, and Puerto Rico, and on various other legumes throughout tropical America. Rust infection, which causes premature defoliation, can reduce yields by 30 to 50 percent. Losses of 100 percent are sometimes reported.

Caused by the fungus *Phakopsora pachyrhizi,* soybean rust is diagnosed by the presence of rusty-colored spots or lesions on the leaves. The host range of the pathogen includes at least 87 plant species in 35 genera of papilionaceous legumes. Because of this wide host range, the fungus has many synonyms. *Phakopsora pachyrhizi* is the name currently accepted, however. First used in 1914, it was the only description at the time that included both the telial (sexual) and the uredial (asexual) stages.

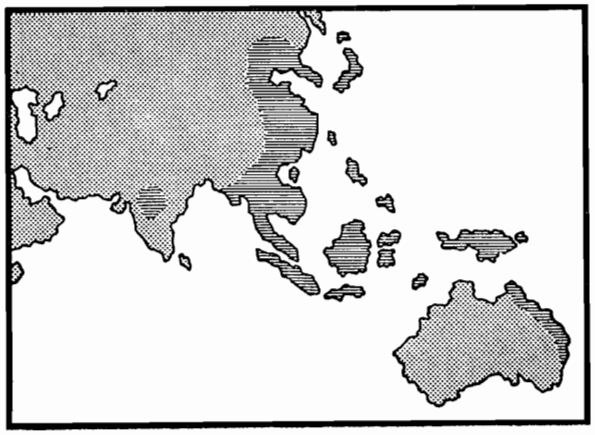
INTSOY and the Asian Vegetable Research and Development Center (AVRDC) in Taiwan have sponsored a cooperative research program on soybean rust. In 1980 Chung-Chuah Yeh, a graduate student in the Department of Plant Pathology at the University of Illinois at Urbana-Champaign, conducted research on soybean rust at AVRDC. The results, summarized below, appear in his Ph.D. dissertation.

Before 1980, scientists had been unable to induce teliospore formation on hosts of *P. pachyrhizi* under controlled conditions. At AVRDC, however, we developed and used a method successfully on 20 cultivars of soybeans and nine other leguminous hosts. In our method, inoculated plants were subjected to 12-hour photoperiods (2,060 lux), 60 to 100 percent relative humidity, and diurnal temperatures between 15°C and 24°C. Once this technique has been used on other hosts, some of the synonyms for the fungus may be eliminated.

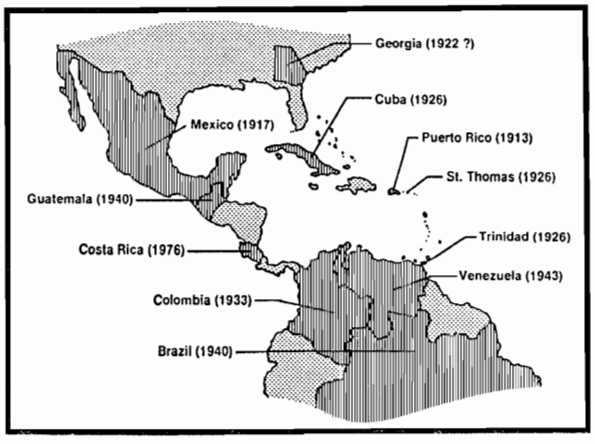
Telia and teliospores formed on both sides of the leaves. Appearing singly and in clusters, young telia were light brown, but darkened with age. Even when only one lesion appeared on a leaf, telia and teliospores were present. We found that an increase in the concentration of inoculum caused an increase in telia production. We also found that genetic factors in the cultivars, rather than the source of inoculum, influenced the production of telia.

Telia can be induced on soybean plants two weeks after emergence. They appeared first and more frequently on the lower leaves, and later and less often on the upper leaves of inoculated plants. Telia were produced two weeks after uredial formation at 10° to 15°C, and in three weeks at 20°C.

In the field, telia formed on soybean leaves infested



Distribution of soybean rust in the eastern hemisphere (darker areas on map).



Distribution of soybean rust in the western hemisphere, and year when first reported.

with *P. pachyrhizi* only when the average daily temperature was below 20°C and the maximum daily temperature less than 29°C. Clearly, telia formation requires periods of cool temperatures.

Rust is probably not transmitted on seeds, because symptoms did not appear on soybeans grown from seeds artificially infested with rust. The fungus may spread from one location to another on air currents. Many common weeds identified as host plants of *P. pachyrhizi* may serve as reservoirs of inoculum as the pathogen spreads into new areas.

We conducted field experiments to evaluate the effect of inoculum concentration and inoculation date on rust development and soybean yield. The concentration of naturally occurring inoculum was so high that the artificial inocula did not influence the development of rust or the yield. Our studies showed that environmental factors, rather than the date of inoculation, affected rust development.

For more detailed information on these studies, write to: C. C. Yeh, Department of Plant Pathology, Taiwan Agricultural Research Institute, Wu-Feng, Taichung, Taiwan; A. T. Tschang, AVRDC, P.O. Box 42, Shanhua, Tainan 741, Taiwan; or J. B. Sinclair, Department of Plant Pathology, N-519 Turner Hall, University of Illinois, 1102 South Goodwin Avenue, Urbana, IL 61801, USA.

KAUFFMAN APPOINTED INTSOY DIRECTOR

On December 21, 1981, Harold E. Kauffman will join the International Soybean Program as Director. A plant pathologist, he brings to INTSOY many years of international experience. Dr. Kauffman has worked for the International Rice Research Institute (IRRI) in the Philippines since 1967. From 1967 to 1971 he served as an IRRI outreach scientist assigned to the All-India Coordinated Rice Research Project. Since 1972 he has coordinated the IRRI international rice testing program.

Dr. Kauffman's primary philosophy is that "we can substantially increase food production and the well-being of mankind through international cooperation. We have just begun to tap the potential which exists in food production, especially in the tropics."

INTSOY is fortunate to have gained the administrative and technical leadership of Dr. Kauffman. William N. Thompson, who has served as INTSOY Director since 1973, will continue as Director of International Agriculture at the University of Illinois at Urbana-Champaign.

TWO STAFF MEMBERS TRANSFERRED

Carl N. Hittle has returned to INTSOY headquarters after extended service in Sri Lanka. Dr. Hittle, who will coordinate the INTSOY system of variety trials, can be contacted at: AW108 Turner Hall, 1102 South Goodwin Avenue, Urbana, IL 61801, USA.

Luis H. Camacho, soybean breeder on the USAID/INTSOY Peru project since 1978, has transferred to the University of Puerto Rico, Mayagüez Campus. Dr. Camacho will continue breeding soybean cultivars adapted to the tropics. His address is: College of Agricultural Sciences, University of Puerto Rico, Mayagüez 00708, Puerto Rico.

PROGRAMS IN PERU AND SRI LANKA

INTSOY participation in soybean development projects in Peru and Sri Lanka changed form in mid-1981 with the expiration of USAID and FAO contracts in those countries. Collaboration will continue through memoranda of understanding, and will include consultations and the exchange of materials and information.

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NO. 28, FEBRUARY 1982

INTSOY RESEARCH HIGHLIGHTS:
ECONOMICS OF SOYBEAN PRODUCTION IN PERU

Under the INTSOY/Peru Soybean Project, researchers have investigated the economic aspects of producing soybeans on small farms in Peru. Supported by the U.S. Agency for International Development (USAID), the project was directed by the government of Peru with INTSOY cooperation. The overall goal of the project was to expand the cultivation of soybeans in high jungle areas and to increase their use in the diet. Four areas of Peru were surveyed in the economic studies: a semi-arid, irrigated region around Jaén and Bagua, and rainfed regions around San Ramón and Satipo, Tingo María and Tocache, and Tarapoto.

From March 1978 to August 1980 Alfred G. Harms, INTSOY production economist, studied the cost of producing soybeans, the amount of labor used during production, and the quantity and quality of the soybeans sold to government purchasing agencies. Also completed were several minor studies that supported the establishment of uniform purchasing prices, provided economic justification for increasing the levels of purchase price, and surveyed the labor required and the cost of various threshing methods. Many Peruvians helped collect data and assisted in other invaluable ways.

The studies of production costs and labor provided the information needed to prepare budgets for proposed production. Extension personnel can use these budgets to promote soybean production, and farmers can refer to them when choosing crops. The budgets also serve as guidelines to credit organizations in establishing realistic loans for production and to government officials in setting purchase prices. Cost data can be used to assess the economic effects of mechanization and other new technology on soybean production.

In 1978, the study included 13 farms near Tarapoto and Tocache. In 1979, 63 farms from all four areas were included. With the help of Peruvian extension agents, simple forms were developed and put into a record book for collecting data on dates, rainfall, type of labor (family or hired), quantity and price of purchased materials, and so forth. Extension personnel helped farmers keep these records. After harvest, the books were collected and the data analyzed.

Due to different methods of operation and planting seasons, wide variations in costs per hectare of soybeans were reported. For all farms surveyed in 1979, the average cost was US$310 and the average yield 1,244 kilos per hectare, or an average of 25 cents per kilogram. The official purchase price was raised in November 1979 from 28 cents per kilogram to 36 cents. These prices resulted in an average net return of $70 per hectare. The information reported here is based on an exchange rate of S/.235 (Peruvian soles) to US$1, which prevailed in the fall of 1979. In general, the average net returns from soybeans were about the same as net returns from corn, sorghum, sunflowers, and cowpeas, but less than the returns from rice and tobacco.

On many farms, labor costs were a large part of the total direct costs. As the level of mechanization increased, labor costs dropped from 87 to 29 percent in 1979. The introduction of appropriate technology and improved work methods can substantially lower the cost of production on both traditional and mechanized farms.

There was also a wide variation in the amount of labor used in each phase of production. In part, the variation was due to differences in rainfall patterns, soil types, weed infestations, use of pesticides and fertilizers, and yields. In 1979, the average number of work days per hectare was 134 for slash and burn operations, 109 for other traditional methods, 76 for low levels of mechanization, and 51 for medium levels of mechanization. Farms that were partly mechanized usually had higher yields than did farms using traditional methods. With mechanization, the total cost of production was greater per hectare, but the larger yields resulted in a lower cost per kilogram of soybeans.

Government purchasing agencies were surveyed in 1978 and 1979 to obtain data on moisture levels, percentage of impurities, and the discounts for excesses above the limits in purchased soybeans. This type of information provides the basis for adjusting the price-discount schedule for equitable settlements to both producers and processors, gives support for making improvements at buying stations, and furnishes background material for extension programs.

Soybean purchases increased from 1,143 metric tons in 1978 to 3,449 tons in 1979. This threefold increase indicates the effects that the INTSOY/Peru Soybean Project had on soybean production.

Weight discounts of one percent were assessed for each percent of moisture above 14 percent. Soybeans with more than 16 percent moisture were rejected for further drying. Nearly all of the soybeans purchased from rainfed areas contained 13 to 16 percent moisture because of poor drying conditions. The bulk of purchases from the semi-arid region tested less than 12 percent moisture. In 1979, the price-discount schedule did not provide premiums for extra dry beans. In general, the soybeans purchased contained less than 4 percent impurities, the level at which weight discounts became effective.

The following reports on the economic aspects of producing soybeans in Peru are available in English and Spanish from INTSOY, 113 Mumford Hall, 1301 West Gregory Drive, Urbana, Illinois 61801, USA (please specify language):

Soybean Production in Peru.

A Study of the Costs of Production and Utilization of Labor in the Production of Soybeans, Peru Soybean Project, 1978.

A Study of the Costs of Production and Utilization of Labor in the Production of Soybeans, Peru Soybean Project, 1979.

Analysis of Soybeans Purchased by EPSA, 1978.

Analysis of Soybeans Purchased by EPSA, 1979.

Also available is the INTSOY Newsletter No. 25 (May 1981), which contains a brief report of the soybean utilization program in Peru.

NEW INTSOY PUBLICATIONS

Three issues in the INTSOY publication series are now available:

Irrigated Soybean Production in Arid and Semi-Arid Regions. Proceedings of a Conference Held in Cairo, Egypt. W. H. Judy and J. A. Jackobs, eds. (INTSOY Series 20).

International Soybean Variety Experiment. Sixth Report of Results, 1978. W. H. Judy, J. A. Jackobs, and E. A. Englebrecht-Wiggans. (INTSOY Series 21).

Soybean Seed Quality and Stand Establishment. Proceedings of a Conference of Scientists for Asia. J. B. Sinclair and J. A. Jackobs, eds. (INTSOY Series 22).

Single copies are available upon request.

COMPENDIUM OF SOYBEAN DISEASES

The American Phytopathological Society has published a revised edition of the *Compendium of Soybean Diseases* by J. B. Sinclair. The book can be obtained directly from the American Phytopathological Society, 3340 Pilot Knob Road, St. Paul, Minnesota 55121, USA. Cost per copy is US$12 plus postage, which is $1.20 for surface mail, $3.88 for air mail to Central America, $6.28 for air mail to South America and Europe, and $8.68 for air mail to other regions.

INTSOY NEWSLETTER

The INTSOY Newsletter is available in three separate editions: English, French, and Spanish. Readers who want to change from one edition to another should write to INTSOY, stating language preference and current mailing address.

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NO. 29, MAY 1982

INTSOY: A WORLD CENTER FOR SOYBEAN RESEARCH IN THE 1980'S AND BEYOND

In recent issues of this newsletter, we have been summarizing INTSOY activities and research. In this issue, we will look at future needs for soybean research and will outline INTSOY's commitment to help meet those needs. We will also examine the possibility of establishing an international soybean center.

Recent exploitation of soybeans. Although soybeans have been grown for many centuries in Asia, their potential has been recognized and exploited elsewhere only during the past several decades. The rapid expansion of soybean production in the western hemisphere, as well as the widespread use of soybeans for humans, livestock, and industry in many parts of the world, is truly a marvel of agricultural research and extension. However, the major benefits from the soybean revolution have been limited primarily to countries in temperate regions.

During the past decade, several international organizations have made efforts to develop technology appropriate to the tropics and subtropics. For example, INTSOY was instrumental in fostering an international network of scientists who have emphasized production, varietal improvement, plant protection, and utilization. The International Institute of Tropical Agriculture (IITA) in Africa has developed genotypes that use local strains of *Rhizobium* to fix nitrogen; these strains are more efficient than introduced strains. The Asian Vegetable Research and Development Center (AVRDC) in Taiwan, China, has developed an active breeding program that now generates improved breeding materials adapted to the subtropics and tropics. The Food and Agriculture Organization of the United Nations (FAO) and the United Nations Development Program (UNDP) have supported the development of soybean programs in several countries.

Colombia, Costa Rica, India, Indonesia, Ivory Coast, Peru, Sri Lanka, and Thailand have established or strengthened their soybean programs through collaboration with international organizations. Costa Rica and Sri Lanka are of special interest because their programs led to the development of an indigenous processing industry that uses locally produced soybeans for preparing foods distributed in the area.

Needs for the 1980's. The challenge for the 1980's is to share the benefits of the soybean revolution with tropical and subtropical countries by helping them develop research and extension programs. Several developing countries have made dramatic gains in cereal production. But these cereals need to be supplemented with high-protein, low-cost foods from crops such as soybeans. Individuals in developing countries currently consume only about half as much protein as do people in developed countries, according to current estimates from FAO. Given the increasing populations and dietary changes, the long-range needs for expanding the production of protein are enormous. Much of the production to meet these needs can come from the tropics and subtropics.

INTSOY's international variety trials have demonstrated the adaptability of soybeans under widely diverse conditions. For example, average yields of the 1979 International Soybean Variety Evaluation Trial (ISVEX) were 1.55 tons per hectare in the tropics, 1.65 in the subtropics, and 1.82 in temperate areas. As cropping becomes more intense in the tropics and subtropics, small-scale farmers have a range of possibilities for introducing soybeans into their cropping patterns. In tropical Asia, for example, rotations of rice and soybeans are very promising.

International cooperation. To help developing nations meet their needs, we must draw upon national, regional, and international resources to strengthen programs that foster the production, marketing, and utilization of soybeans. Several elements should be included in this effort:

- Intensified collection, maintenance, and use of germplasm to broaden the germplasm base.
- A strong focus on marketing, processing, utilization, and nutrition to develop foods and products to meet local needs.
- Strong, well-defined programs in research and development. These programs should be mission-oriented and interdisciplinary in order to solve complex problems.
- Increased exchange of germplasm, technical personnel, research results, and technical publications to provide the tools that will help researchers in developing countries strengthen their institutions.
- Development of production practices to optimize

and stabilize yields under widely diverse systems of farming.

- Development of a partnership among research organizations, governments, development banks, and private industries for the purpose of creating an international soybean center.

Proposed international center. If we are to meet the challenges of the future, INTSOY must significantly strengthen its capabilities for research, outreach, and training. Recently, several groups explored the idea of establishing an international soybean center. This center would promote the production and utilization of soybeans for the benefit of all peoples. From discussions about the proposed center, a general organizational structure has emerged:

- The center must be an autonomous, international institute.
- An international board of trustees would develop policies for the center.
- Headquarters would be in an area where strong programs in research, production, and utilization now exist.
- Regional centers would be established in Africa, Latin America, and Asia (possibly with centers in China, India, and one of the Southeast Asian countries). These centers would strengthen existing national, regional, and international programs by providing assistance with financing, personnel, and other resources. The centers should be closely linked to one another through vigorous activities within the network.
- A small staff of international scientists of the highest caliber would be hired.
- A strong core of service staff would be responsible for transferring technology and would serve the varied needs of the network.
- The center would draw upon a broad source of funding from various governments, private foundations, development banks, and private industries. It would operate much like the international agricultural research centers funded by the Consultative Group for International Agricultural Research (CGIAR), but individual donors would fund components of the activities in a particular program area or on a regional or national basis.

The time appears right for the worldwide soybean community to join INTSOY in forming an international soybean center to address global needs. We believe that INTSOY with some institutional changes and a major increase in financial support, can provide the basic organizational structure for such a center. To this end, INTSOY plans to work collaboratively with other interested institutions and governments around the world. As we move ahead in this important task, we welcome your suggestions and support.

SOYBEAN PRODUCTION COURSE

The Instituto Colombiano Agropecuario (ICA) and INTSOY are now planning the third soybean production course, which will be taught in Spanish. Designed for people in research, extension, and production, this three-week course will be held in Palmira, Colombia, beginning on November 24, 1982. The fee is US$1,000 per person. This fee does not include international travel or a living allowance. Write to INTSOY for more information.

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International Soybean Program
INTSOY NEWSLETTER

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NO. 30, AUGUST 1982

IMPROVED VARIETIES FOR DEVELOPING COUNTRIES

An important goal of INTSOY is to develop improved germplasm for production of soybeans in the tropics and subtropics. Scientists conduct the necessary research in plant breeding and agronomy at the University of Puerto Rico, Mayagüez Campus; the Isabela Agricultural Experiment Station in Puerto Rico; and the University of Illinois at Urbana-Champaign. INTSOY cooperators throughout the world then test the best cultivars from this program and also from various national programs.

INTSOY has three interrelated variety testing programs: Soybean Initial Evaluation Variety Experiment (SIEVE); Soybean Preliminary Observation Trial (SPOT); and International Soybean Variety Evaluation Experiment (ISVEX).

During SIEVE and SPOT, promising cultivars are selected for later testing in ISVEX. Since the beginning of SIEVE in 1978, 42 breeders and agriculturalists from 20 countries have contributed 152 cultivars for preliminary testing. The cultivars entered in SIEVE are evaluated at four locations. In 1981, SIEVE was conducted in Colombia, Puerto Rico, Sri Lanka, and Texas, USA.

SPOT tests the promising lines from SIEVE. Two SPOT trials are conducted in each of nine different environmental zones, where cooperators collect data for analysis. Information from the analyses, along with the researchers' observations, is the basis for determining ISVEX entries. Last year 21 researchers from 19 countries collaborated in SPOT, and 21 cultivars were evaluated for adaptation and agronomic qualities.

During ISVEX, cultivars having a broad range of adaptability are identified. ISVEX is a cooperative program between INTSOY and agricultural institutions, universities, and organizations in 112 participating countries. Fifty percent of these countries are in the tropics, 30 percent in the subtropics, and 20 percent in temperate zones. An average of 100 cooperators conduct the experiments each year. As a result of ISVEX participation, cooperators in Egypt, India, Peru, Sri Lanka, and Turkey have identified cultivars and lands for large-scale soybean production.

Each year INTSOY publishes the results of ISVEX trials in its publications series. Data reported include a computer analysis of each trial, an analysis of combined results, and interpretations of the results. Soon after the return of production data, cooperators in ISVEX receive a detailed computer analysis of their individual trials.

From cultivar evaluation, which is a measure of agronomic characteristics and the interaction between cultivars and locations, we can make some generalizations:

— The protein and oil content of a cultivar remains stable in different sites and environments.

— In the tropics, yields tend to be larger from later maturing cultivars than from early maturing cultivars.

— Yields are comparable in tropical and temperate regions.

— Shattering and lodging are seldom serious problems.

— Seed size is not related to yield.

— Plants are affected more by changes in altitude than by changes in latitude.

— Yields from a newly introduced crop are usually good.

— Chemical composition of seed is comparable in all environmental zones.

— Seed quality is a universal problem, but small seeded varieties have better seed quality than large seeded varieties.

Poor nodulation is a major problem in popularizing soybean cultivation in the tropics. Eventually we hope to develop high yielding soybean varieties with an inherent capacity to form nodules from the *Rhizobium* occurring naturally in tropical soils. The International Institute of Tropical Agriculture (IITA) has been conducting research to identify freely nodulating soybean lines and to study the inheritance of the nodulation characteristic. INTSOY will be cooperating with IITA to expand this work.

INTSOY's variety testing program provides a structure for building cooperative relationships, transmitting knowledge, opening lines of communication, developing field experience, and acquiring research expertise. Most importantly, the program

enables us to distribute improved germplasm throughout the world. We would like to acknowledge the contributions of all the cooperators, who have provided more than 140 promising soybean accessions and conducted 1,800 research trials.

Breeders who wish to contribute cultivars to this year's SIEVE and researchers who would like to participate in ISVEX should write to Dr. Joseph A. Jackobs, University of Illinois, INTSOY/Agronomy, AW-117 Turner Hall, 1102 South Goodwin Avenue, Urbana, Illinois 61801, USA. To obtain a copy of the latest ISVEX results, write to INTSOY and ask for the "International Soybean Variety Experiment, Sixth Report of Results, 1978," by W. H. Judy, J. A. Jackobs, and E. A. Engelbrecht-Wiggans (INTSOY Ser. no. 21).

SHORT COURSES COMPLETED

Participants recently received certificates upon completion of the two INTSOY-sponsored short courses. Twelve people attended the course on the Technical and Economic Aspects of Soybean Production: Vital A. Valdivia, Chile; Mahmoud Zaki Hassan, Egypt; Ahmad Dimyati, Indonesia; Wilfred A. Nzabi, Kenya; Jinasiri Fernando, Denzil Francisco, and W. Ratnayake, Sri Lanka; Mahmoud Y. Sabbouh, Syria; Elizabeth T. Marenge, Tanzania; Mbikayi N. Tshidimba and Mukishi M. Pyndji, Zaire; and Jacob S. Tichagwa, Zimbabwe.

Ten people completed the course on Soybean Processing for Food Uses: Nefisa El-Banna and Nagy Hassan Helmy Abdel-Hamid, Egypt; Geunha Lee, Korea; Hadi K. Purwadari and Dedi Fardiaz, Indonesia; B. Ali Asbi, Malaysia; Salahuddin Solaiman, Pakistan; Bai Dido T. Samama, the Philippines; Nomakhosi Mlambo, Swaziland; and Mary Chamisa Musaka, Zambia.

John W. Santas, INTSOY, led the production course, which was conducted for the eighth time. L. S. Wei, Department of Food Science, University of Illinois at Urbana-Champaign, was technical leader of the processing course, which was offered for the seventh time.

WORLD CONFERENCE

The World Soybean Research Conference III will be held at Iowa State University, Ames, Iowa, USA, from August 10 to 17, 1984. James B. Sinclair is INTSOY's representative on the executive committee. If you have suggestions about topics or speakers, write to James B. Sinclair, University of Illinois, Department of Plant Pathology, N-519 Turner Hall, 1102 South Goodwin Avenue, Urbana, Illinois 61801, USA.

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NO. 31, NOVEMBER 1982

REPORT ON REVIEW OF CONTRACT

A team composed of five people recently reviewed the current three-year contract between the University of Illinois and the U.S. Agency for International Development (USAID), which funds INTSOY activities. In its final report, the team recognized INTSOY for several accomplishments: evaluation of germplasm; research in agronomy and in diseases and insects affecting soybeans; training; and the dissemination of information.

INTSOY now plays an important role in international research and development. The team therefore recommended that funding be increased significantly so that INTSOY can respond to the many requests from national programs and expand its worldwide coordination of research activities in soybean production, marketing, processing, and utilization. The team noted that INTSOY can achieve these goals most effectively through its incorporation as the International Soybean Center.

REVIEW OF GERMPLASM COLLECTION

Under the sponsorship of the International Board of Plant Genetic Resources and INTSOY, a working group met from August 9 through 11, 1982, to review the status of soybean germplasm collections and to identify areas where documentation, collection, and maintenance should be accelerated during the next five years. The following countries and organizations, all of which maintain collections, sent participants: Australia, Japan, Korea, the United States, the Asian Vegetable Research and Development Center (AVRDC), and the International Institute of Tropical Agriculture (IITA).

The group recommended that existing collections of *Glycine max* and *G. sojae* should be documented further and that additional germplasm should be collected in areas such as western and southern China, Vietnam, Laos, Burma, the Himalayan areas of India and Nepal, and Japan. Perennial species should also be collected in Australia and Papua New Guinea. The working group developed descriptors to standardize germplasm records. When completed, the list of descriptors will be used in germplasm maintenance and in breeding programs.

CHINA/USA SOYBEAN SYMPOSIUM

The College of Agriculture, University of Illinois at Urbana-Champaign, hosted the first China/USA Soybean Symposium from July 26 through 30, 1982. More than 220 scientists participated. The symposium dealt with the economic aspects of soybeans in China and the United States and provided a basis for cooperative research programs that will benefit consumers and producers in both countries. The U.S. Department of Agriculture, Office of International Cooperation and Development, provided financial support for the symposium. The second China/USA Soybean Symposium will be held in China in July of 1983. Proceedings of the 1982 symposium will be published next year in the INTSOY publications series.

PROGRESS IN TROPICAL AND SUBTROPICAL COUNTRIES

Several developing countries in the tropics and subtropics have made significant progress in production, processing, and utilization of soybeans in the past few years. Benefits to the people through improved nutrition and to the economy of individual countries have been significant. Recent developments in five countries on three continents are summarized below.

Costa Rica. Costa Rica has developed a food industry that utilizes locally produced soybeans, primarily for baby foods and bread. CARE has taken the leadership in promoting the food products. Production has increased to approximately 4,000 hectares to meet expanding needs.

India. The heavy demand for vegetable oil in India has led to the widespread use of soybean oil, which became popular through imports. The Madhya Pradesh Oil Seed Federation Cooperative has used funds generated from local sale of the oil to promote marketing and utilization of soybeans. The Cooperative is now establishing other cooperatives for production and processing. In 1981 economic benefits to small-scale farmers who cultivated soybeans as a second crop exceeded US$75 million from the 600,000 hectares. Five new processing plants are under construction in Madhya Pradesh, and an

accelerated national research program is under way to exploit the protein potential for increased use in the human diet.

Egypt. Egypt's need for oil and protein is stimulating the production of soybeans. However, unless new varieties that mature early are developed for planting in rotation with rice, the 125,000 hectares currently under production cannot be increased substantially. Expanded work on utilization of soy protein and modernization of processing plants will help increase the use of soybeans.

Sri Lanka. Government and private industry are working together to expand production and processing in order to meet the increasing demand of consumers for products made from the whole bean, textured vegetable protein, and substitutes for coconut milk.

Turkey. Turkey needs large quantities of soybeans for vegetable oil, animal feed, and protein for humans, but lack of foreign reserves has limited soybean imports in the past. Turkey has therefore started producing soybeans as a second crop following wheat in the Mediterranean coastal area. Approximately 25,000 hectares were planted in 1982, and the area is expected to expand to more than 100,000 hectares during the next few years.

SYMPOSIUM: SOYBEANS IN TROPICAL CROPPING SYSTEMS

The Asian Vegetable Research and Development Center, the Japanese Tropical Agricultural Research Center, INTSOY, and the International Institute of Tropical Agriculture are sponsoring a symposium entitled "The Use of Soybean in Tropical Cropping Systems." This international symposium will be held in Tsukuba, Japan, September 27 to 30, 1983.

The symposium has four main objectives: (1) to examine the state of knowledge about soybean utilization in tropical and subtropical cropping systems, (2) to identify the constraints that limit yields in these systems, (3) to establish an agenda for research on cropping systems using soybeans and cereals, and (4) to develop a strategy for disseminating information on soybean/cereal cropping systems. The sponsoring organizations will provide additional information about the symposium upon request.

STAFF CHANGE

Dr. Robert M. Goodman, virologist, is taking a one-year leave to work with Calgene, Inc., in Davis, California. During his absence, Dr. Jacqueline Fletcher will be responsible for research related to soybean viruses. Her mailing address is: Department of Plant Pathology, N-519 Turner Hall, 1102 South Goodwin Avenue, University of Illinois, Urbana, IL 61801, USA.

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NO. 32, AUGUST 1983

SRI LANKA: A MODEL FOR SOYBEAN DEVELOPMENT

A factory for producing dried soy milk, recently opened at Maha Illuppallama, Sri Lanka. The factory can produce 4 metric tons per day.

Prepared commercially, dried soy milk is one of several soyfoods that people consume in Sri Lanka. Many other soyfoods are prepared in homes and villages. A recent survey in the dry zone, where soybeans are most commonly grown, showed that:

- 73 percent of the people have eaten soyfoods,
- 42 percent have soy products in their homes,
- 29 percent eat soyfoods at least once a week,
- 40 percent consider soyfood easy to prepare,
- 47 percent consider soyfoods reasonably priced,
- 48 percent can buy soybeans locally.

In Sri Lanka, interest in soybeans as a crop and as a food began in 1973. Before then, farmers raised only small quantities in the Maturata District on the ridges of terraced rice paddies. The introduction of soybeans in Sri Lanka, which is described here, can serve as a model for similar development in countries where human diets are deficient in calories and protein.

According to a government survey in 1969, 50 percent of the Sri Lankan population were not getting enough calories, and 40 percent had too little protein. Malnutrition was most common among preschool children. Sri Lanka imported two-thirds of its milk at a cost of US$9 million, which strained the national foreign exchange. Interest in soybeans as a food crop grew because soy milk can extend or replace cows' milk and serve as a substitute for coconut milk in cooking.

The first agronomic trials for syobeans were conducted in 1967 at the Maha Illuppallama Agricultural Research Station in the dry zone. The late Mr. William G. Golden of the International Rice Research Institute/Sri Lanka Ford Foundation Rice Project was instrumental in promoting soybean testing. He also helped establish communications between Sri Lanka and INTSOY, which furnished seed for numerous trials. These trials showed that soybeans are well adapted to the dry zone in Sri Lanka and that large yields are possible.

Dr. Leslie Herath, then Assistant Secretary of Agriculture, asked the United Nations Development Program (UNDP) to support a soybean program until the crop and its use in the human diet became well established. Mr. M. Jalil and Dr. H. A. Al-Jibouri, both with the Food and Agriculture Organization (FAO) of the United Nations, prepared a proposal for the development of soybeans. The government of Sri Lanka then submitted the proposal to UNDP. In February, 1975, INTSOY signed a contract to help the government of Sri Lanka implement the Sri Lanka Soybean Development Program.

Program leaders decided to promote soybeans for human consumption rather than for oil or animal feed. Dr. C. N. Hittle, an INTSOY plant breeder, served as INTSOY project leader. Dr. H. M. E. Herath, Deputy Director of Agricultural Development, Ministry of Agriculture and Land Development, served as the Sri Lankan Program Director and Coordinator.

In the first stage of the program, it was necessary to identify soybean cultivars adapted to Sri Lanka. It was also necessary to develop cultural practices for their cropping systems and an extension system to teach farmers the new techniques. By 1982, annual soybean production had increased to 8,000 metric tons, raised on more than 10,000 hectares.

During the second stage, program leaders established a Soybean Foods Research Center, which includes a pilot plant to develop and produce soyfoods and a training facility. CARE and UNICEF (United Nations Children's Fund) provided funds to construct and equip both.

Opened on April 29, 1979, the Center perfects local recipes, develops and processes commercial soyfoods, and advises entrepreneurs interested in marketing soyfoods. The Home Level Training and Cookery Demonstration Program had started in September, 1978. This training facility, adjacent to the pilot plant, contains 21 cooking units that can accommodate 30 trainees at a time.

The third stage involved marketing and introducing soyfoods through various government, commercial, home, and village programs. Extensive use of

soyfoods began in 1976, when CARE purchased 26,000 kilograms of locally grown soybeans for use in its Thriposha feeding program. In July, 1979, the first center for the commercial sale of soyfoods opened in Colombo. Noodles, flour, beverage, cutlets, and ten other soyfoods were on sale.

Soyanews, a monthly newsletter published by CARE for the Sri Lanka Soybean Development Program, is instrumental in promoting soybeans and improving nutrition. The newsletter is published in Sinhala, Tamil, and English with articles on soybean cultivation, marketing, processing, and use.

Sri Lankans have accepted soyfoods into their diets in a remarkably short time. This success is due to cooperation between Sri Lankan consumers and government agencies. International agencies have hastened the development with financial and technical assistance.

NEW INTSOY PUBLICATIONS

Three issues in the INTSOY publication series are now available:

International Inoculant Shipping Evaluation, R. S. Smith, W. H. Judy, and W. C. Stearn. INTSOY Series 23.

International Soybean Variety Experiment, Seventh Report of Results, 1979. J. A. Jackobs, M. D. Staggs, and D. R. Erickson. INTSOY Series 24.

Soybean Research in China and the United States. Proceedings of the First China/USA Soybean Symposium and Working Group Meeting. B. J. Irwin, J. B. Sinclair, and Wang Jin-ling, eds. INTSOY Series 25.

Single copies are available upon request.

SHORT COURSE OUTLOOK

INTSOY will offer two training courses in 1984. Technical and Economic Aspects of Soybean Production will be held May 28 to August 17. Soybean Processing for Food Uses will be held May 14 to July 29. Participants in the production course will attend the World Soybean Research Conference III at Iowa State University. Participants in the processing course will attend the Annual Conference and Food Expo of the Institute of Food Technologists (IFT) in Anaheim, California. Additional information is available from John W. Santas, INTSOY.

BREEDING WORKSHOP IN COLOMBIA

The first Latin American Soybean Varietal Improvement Working Group Meeting was held in Palmira, Colombia, June 20 to 23. Plant breeders attended from Argentina, Bolivia, Brazil, Colombia, Ecuador, Guatemala, Mexico, Peru, the United States, Uruguay, Venezuela, the Asian Vegetable Research and Development Center (AVRDC), and INTSOY. The group discussed those breeding strategies necessary to develop improved varieties of soybeans for tropical and subtropical environments. They identified several special concerns: early maturity, seed quality, photo insensitivity, resistance to diseases and insects, problem soils (especially acid soils), and tolerance to high temperatures. International and regional cooperation will greatly expedite progress in genetic development. The Instituto Colombiano Agropecuario (ICA) and the Centro Internacional de Agricultura Tropical (CIAT) were hosts for the meeting, FAO provided the funds, and INTSOY coordinated plans.

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NO. 33, NOVEMBER 1983

INTSOY RESEARCH HIGHLIGHTS: SOYBEAN VIROLOGY

Virology researchers at INTSOY investigate many questions related to soybean viruses and mycoplasma-like organisms (MLOs), including their characteristics, transmission, detection in hosts, and control. In the past year, research has centered on three major areas: the epidemiology of soybean mosaic virus (SMV); machismo disease, which is caused by an MLO; and geminiviruses transmitted by whiteflies.

Soybean mosaic virus. SMV reduces the yield of infected crops and is economically damaging in several tropical and subtropical countries. The long-range goal of our research is to understand the numerous ecological factors that affect the spread of the virus and the damage that it causes. The production of disease-resistant soybeans will be aided by identifying and understanding the factors that affect breeding programs.

INTSOY plant breeders and pathologists continue to develop soybean cultivars that are resistant to SMV. As reported in INTSOY Newsletter No. 21 (May 1980), our studies identified seven related strains of SMV according to the symptoms produced on several soybean lines. Recently, we evaluated a number of SMV isolates from the People's Republic of China and found additional strains, some much more virulent than those previously known. Other experiments on seed transmission of SMV determined that some strains are unstable. These genetic studies are important for worldwide control of this virus.

Machismo disease of soybeans. The first report of machismo came from Colombia in 1967. Colombian scientists characterized the causal agent as a mycoplasma-like organism. INTSOY scientists recently studied a disease in Mexican soybeans whose symptoms closely resembled machismo. In the affected fields we also collected many leafhoppers of the species *Scaphytopius fuliginosis*, the only known vector of machismo. Electron microscopy revealed MLOs in the tissue of symptomatic plants. We believe that the disease in Mexico is machismo, and this finding broadens the known geographical range of the disease.

Geminiviruses transmitted by whiteflies. A third area of INTSOY research involves the detection, characterization, and importance of geminiviruses transmitted by whiteflies. Some of these newly recognized viruses are pathogens of soybeans in tropical countries. The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and INTSOY are collaborating in a project to identify the causal agent of another suspected geminivirus in India, soybean yellow mosaic. Through this project, scientists expect to identify plants that may act as sources for inoculum, identify hosts of the whitefly vector, and determine relative abundance of this vector. Information about the ecology of the disease will facilitate its control through cultural practices. The study will include techniques recently developed by INTSOY virologists for bean golden mosaic virus (BGMV).

INTSOY supported basic research in BGMV genetics that contributed to the discovery of geminiviruses. The work also led to the development of a powerful new tool to detect and positively identify infections caused by geminiviruses. The research showed that BGMV is caused by a novel kind of virus, now called geminivirus for its unique twin-sphere shape. Most plant viruses use single-stranded RNA to carry their genetic information, but BGMV uses single-stranded DNA.

Further work showed that BGMV could be used as a model for all geminiviruses. Using modern techniques of molecular biology, we are able to diagnose diseases as geminiviruses when infected plants are found to contain genes related to those of BGMV. Enzymes that cut DNA at specific sites make it possible to obtain unique "fingerprints" or patterns of DNA fragments particular to each geminivirus. Radioactive labelling based on hybridization (specific bonding) of complementary DNA is used to detect these patterns.

This approach is approximately 1,000 times more sensitive than the alternative method, which is based on detecting the protein of the virus coat. Unlike the alternative method, our approach can distinguish different but related viruses. It is especially practical because it is possible to obtain

precise diagnoses from small amounts of field specimens. The work that led to the characterization of BGMV and its application in the new detection method shows that careful field observations and basic research are indispensable to each other.

This genetic "fingerprint" approach has already diagnosed distinct geminivirus diseases of soybeans in Colombia. It has also identified a new weed reservoir host for BGMV. This latter finding probably would not have been made through conventional studies of transmission and symptoms because the reported experimental host range extended to only a few legume species. The new host is a perennial malvaceous weed that does not exhibit symptoms when infected.

Geminivirus infections appear to be mainly tropical, but we may have identified a new geminivirus associated with island chlorosis disease found in the hackberry *(Celtis occidentalis)*, a native North American tree in the elm family. The causal agent of island chlorosis has long eluded researchers. One clue was that the symptoms of island chlorosis on hackberry resembled those induced by known geminiviruses in several tropical plants. Using our new genetic detection method, we quickly identified the diagnostic features of a probable new geminivirus.

We are now applying this detection method to the diagnosis of suspected geminiviruses from around the world.

Please contact INTSOY for more information on this research. Samples of SMV-resistant cultivars are available to cooperating scientists on request.

INTSOY EXPANDS REGIONAL SOYBEAN COLLABORATION

After ten productive years, the partnership between the University of Illinois at Urbana-Champaign and the University of Puerto Rico, Mayaguez Campus, ended in October, 1983. INTSOY plant breeder Dr. Luis H Camacho has transferred to the Centro Internacional de Agricultura Tropical (CIAT) in Cali, Colombia. He will work closely with the Instituto Colombiano Agropecuario (ICA) and with soybean improvement programs elsewhere in the region. Dr. W. Chris Stearn, INTSOY microbiologist, is now stationed at the Asian Vegetable Research and Development Center (AVRDC) in Shanhua, Taiwan. Dr. Stearn will conduct microbiology research programs in Asia. Closer collaboration with CIAT and AVRDC will strengthen INTSOY's regional research and development activities.

Dr. Camacho's new address is: CIAT, Apartado Aereo 6713, Cali, Colombia. Dr. Stearn can be contacted at AVRDC, P. O. Box 42, Shanhua, Tainan 741, Taiwan.

SEMINAR ON SOYBEAN UTILIZATION FOR AFRICA

The International Institute of Tropical Agriculture (IITA), INTSOY, and the American Soybean Association are sponsoring a seminar on soybean uses at IITA in Ibadan, Nigeria, December 5 to 9. African scientists and administrators will discuss ways to promote soybean use in Africa.

SECOND CHINA/USA SOYBEAN SYMPOSIUM

The Second China/USA Soybean Symposium was held in Jilin Province, People's Republic of China, July 28 to August 2, 1983. Twenty-five scientists from the United States and sixty Chinese scientists presented papers and discussed current research activities. The U.S. Department of Agriculture, Office of International Cooperation and Development, and the Chinese Ministry of Agriculture, Animal Husbandry, and Fisheries sponsored the symposium.

WORLD SOYBEAN RESEARCH CONFERENCE III

Scientists who plan to present papers at the World Soybean Research Conference III at Iowa State University, Ames, Iowa, USA, August 12 to 17, 1984, should contact Dr. Walter R. Fehr, Department of Agronomy, Iowa State University, Ames, Iowa 50011, USA. Information about the conference is available from Dr. Fehr.

SOYBEAN GERMPLASM DOCUMENTATION

At the request of the International Board for Plant Genetic Resources (IBPGR) Soybean Germplasm Advisory Committee, INTSOY is conducting a survey of soybean germplasm collections maintained worldwide. Survey questionaires have been mailed out and prompt return would be appreciated. If you have a soybean germplasm collection and have not been contacted, please write to INTSOY. Survey results will be published by INTSOY and IBPGR.

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International Soybean Program
INTSOY NEWSLETTER

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SOYBEAN RESEARCH NETWORK

INTSOY, AVRDC (Asian Vegetable Research and Development Center), and IITA (International Institute of Tropical Agriculture) are developing a Letter of Agreement to cooperate in regional soybean improvement networks for Latin America, Asia, and Africa. The networks will strengthen regional cooperation among soybean scientists and accelerate the development of high-yielding cultivars that are adapted to local conditions and cropping systems in the tropics and semitropics. IITA will lead the African network, AVRDC will lead the Asian network, and INTSOY will lead the network for the tropical regions of Latin America and the Caribbean Basin. Network activities in Africa will be planned during the annual meetings at IITA of the High-Yielding Varieties Technology Project funded by the Commission of European Communities. A workshop in Colombia in June 1983 laid the groundwork for the Latin American network. The planning meeting for Asia was held in July 1984 in Indonesia. AVRDC, IRRI's Asian Farming Systems Network, and INTSOY were the sponsors.

The networks will initially emphasize cultivar improvement activities. Cultivar trials, composed of the best entries from international organizations and national programs, will be established for each region. The international trials will complement the regional trials and, where appropriate, they will be integrated with them.

Representatives of the networks will report to the world soybean community at meetings such as the World Soybean Research Conferences and the annual meeting of the international agricultural centers in the Consultative Group for International Agricultural Research (CGIAR). A new International Soybean Research Newsletter will also help to disseminate information.

Research and development activities in other aspects of production, processing, and use may be added to the regional network programs in the future.

INTSOY TO STRENGTHEN UTILIZATION RESEARCH

In the early 1970s, USAID funded an active INTSOY utilization research program. But as research funds were reduced in the mid-1970s, INTSOY had to rely on other sources of funds to conduct soyfood utilization research. The United Nations Development Program (UNDP) sponsored activities from 1976 to 1981 in the Sri Lanka Soybean Utilization Project, and we had a separately funded USAID project in Peru from 1977 to 1981. These projects established strong utilization programs and developed processing technology and extension mechanisms appropriate for other countries.

In the middle of 1984, INTSOY channeled some resources from its current USAID research contract to a modest soyfood research program at the University of Illinois at Urbana-Champaign (UIUC). We are working to improve processes for making soy beverages, to develop a range of extruded soy products and uses for whole soybeans in village and home processing, and to evaluate simple oil extraction techniques. Initial activities are modest but they will help scientists, government officials, and private industry establish regional and national soybean utilization programs. The Department of Food Science at UIUC recently moved into a new research facility that has the most modern food research processing equipment.

INTSOY is now talking with IITA, AVRDC, and UNDP/FAO about possible cooperative utilization activities in Africa and Asia.

ASIAN SOYBEAN NETWORK MEETING IN INDONESIA

INTSOY, AVRDC, and IRRI, in cooperation with FAO, sponsored a meeting of Asian Soybean Cultivar Improvement Scientists in Indonesia from July 16 to 22, 1984. Forty scientists from 17 countries attended. Participants toured soybean growing areas prior to the two-day meeting, where they reviewed current activities of national pro-

grams and developed plans to strengthen regional cooperation through the establishment of an Asian Soybean Collaborative Network. Most Asian countries are interested in increasing production to help meet the rapidly expanding demands for edible oils and soyfoods.

NEW INTSOY PUBLICATION

International Soybean Variety Experiment, Eighth Report of Results, 1980-1981, by J. A. Jackobs, C. A. Smyth, and D. R. Erickson (INTSOY Series Number 26) is now in print. Single copies are available upon request.

ASIAN SOYBEAN UTILIZATION WORKSHOP

The Sri Lankan Soybean Project and INTSOY, in collaboration with FAO, CARE, USAID, UNDP, and UNICEF, will hold a workshop at the Soybean Foods Research Center at Gannoruwa, Peradeniya, Sri Lanka, from January 14 to 26, 1985. The workshop will concentrate on the organization of national soybean projects and the utilization of soybeans in foods and food products that appeal to the eating habits of Asian consumers. Food scientists and processors, nutritionists, home economists, policy makers, and administrators who manage projects designed to establish soybean production and expand the use of soybeans for human food will benefit most from this workshop. Contact Dr. John W. Santas, INTSOY, for information.

INTSOY SHORT COURSES

In mid-August participants will receive certificates for completing the two short courses sponsored by INTSOY. Sixteen people attended the course on the Technical and Economic Aspects of Soybean Production: U Tun Thein, Nyunt Nyunt Wai, and Shirley Smellie, Burma; Wang Peiying and He Zhihong, People's Republic of China; Eduardo J. Mata M. and Luis Ricardo Quiros U., Costa Rica; Yehia Soliman Gayed, Egypt; Titis Adisarwanto, Indonesia; Toru Kawakami, Japan; Arsene Williams Randriamamonjy and David Rakotoalivao, Madagascar; Mir Hatam, Pakistan; Shu-Ching Wu, Taiwan; Supon Thanooruk, Thailand; and Stanislous Nkumbula, Zambia.

Ten people participated in the course on Soybean Processing for Food Uses: Ileana Granados, Costa Rica; Balint Czukor, Hungary; Kyong-Soo Hwang, Korea; Dulce María Muñoz-Pérez and Eduardo Ignacio Molina C., Mexico; M. Akmal Khan, Pakistan; Guillermo Reyes V., Panama; Khanyisile S. Mabuza, Swaziland; and Scholastica Mabuya and Eleanor Muzyamba, Zambia.

John W. Santas, INTSOY, led the production course, which was conducted for the ninth time. L. S. Wei, Department of Food Science, UIUC, was technical leader of the processing course, which was offered for the eighth time. Write INTSOY for information and dates on next year's courses.

INTSOY NEWSLETTER

The INTSOY Newsletter is available in three separate editions: English, French, and Spanish. Readers who want to change from one edition to another should write to INTSOY, stating language preference and current mailing address.

INTSOY Newsletter es disponible en tres ediciones separadas: inglés, francés y español. Los lectores que deseen cambiar de edición pueden hacerlo escribiendo a INTSOY especificando el idioma preferido y dirección postal actual.

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INTSOY, a program of the University of Illinois at Urbana-Champaign, cooperates with national, regional, and international organizations to expand the use of soybeans. INTSOY provides equal opportunities in programs and employment. The INTSOY Newsletter is supported in part by the U.S. Agency for International Development (USAID); the views and interpretations are those of INTSOY and should not be attributed to USAID or any individual acting in its behalf.

INTERNATIONAL SOYBEAN PROGRAM

University of Illinois
at Urbana-Champaign
College of Agriculture

INTSOY

NEWSLETTER

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INTSOY Develops New Techniques For Commercial Soymilk Processing

One of the best methods for converting soybeans to a high-quality food is to produce the beverage known as soymilk. Commercial processing equipment for making sterile soymilk in containers at an average capacity of 2,000 liters per hour is currently available for purchase from a number of sources at a cost of several million dollars. At present, however, there is a lack of inexpensive equipment and proven processing techniques for producing sterile product at volumes larger than the home level and less than 600 to 800 liters per hour.

As a result, INTSOY research conducted by utilization program leader Alvin I. Nelson and research associate Sing-Wood Yeh has focused on scaling up improved soymilk processing techniques from the laboratory to the medium commercial scale. A commercial supply of soymilk is especially important for people who are allergic to the lactose in cow's milk. The discomfort caused by lactose intolerance limits intake of milk as a source of protein. This condition may also interfere with the absorption of protein and other nutrients.

Although the problem is less severe in the United States and Europe, the inability to digest the milk sugar lactose occurs widely in developing nations. Rates from 50 percent to almost 100 percent have been recorded among populations in Asia, Africa, and Latin America.

Research associate Sing-Wood Yeh adjusts tofu-making equipment adapted for producing soymilk. After passing through a rotating screen, the soymilk flows into a holding tank (left). The okara or residue (bottom) can be used immediately in baking or dried for later use as a high-fiber flour.

Because soymilk contains no lactose and is less costly to produce, it offers an attractive alternative to cow's milk for hundreds of millions of people in developing countries, as well as many people in developed countries. Soymilk is also completely free of cholesterol, which makes it especially appealing for health food markets around the world.

The new commercial-scale processing technique being developed by INTSOY represents a major step toward meeting this huge worldwide need for soymilk. The process begins with soybeans that have been cleaned and sized. The beans are dried by forced air in an oven and split while still hot in a dehuller roller. The hulls and the cotyledons are then separated using an air blower.

Overcoming the soymilk acceptance problem. The next steps in the commercial process are crucial for preventing the beany flavor that has made traditional soymilk products largely unacceptable to people outside the Orient. This distinctive beany flavor is caused by the action of an enzyme in the soybeans when they are ground and exposed to moisture and oxygen.

The basic flavor problem, however, was solved as early as 1970 with a beverage developed by food scientists at the University of Illinois. The product is made by cooking and grinding the beans in a way that inactivates the enzyme which causes the objectionable flavor.

The method known as the Illinois Process utilized the whole soybean and produced a soy beverage with bland flavor, excellent suspension stability, and good flavor characteristics. Serious acceptance problems ensued, however, because the product tended to leave a chalky feeling in the mouth. Patent restrictions further limited use of this process in many less developed areas.

More recently an inexpensive technique was developed for preparing soymilk at the home and village level.

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The improved home and village preparation process in simplified form is as follows:

- Blanch whole dried beans in boiling water containing a small amount of sodium bicarbonate.
- Drain the blanch water, add boiling water, and grind the beans in an electric blender or hand grinder.
- Stir the slurry well and filter with a finely woven, moist cheesecloth. Squeeze out as much milk as possible.
- Simmer the filtrate.

Heat treatment is the most important step in preparation of soymilk. When making the slurry, it is absolutely necessary to hydrate and thoroughly heat the raw soybeans before grinding them to prevent development of the typical beany flavor. The entire cooking process also adequately destroys the antinutritional trypsin inhibitor.

Longer than recommended boiling times will reduce the amount of protein in the final product. The concentration of solids can be adjusted according to the final use of the soymilk.

For the commercial process, the cleaned, dehulled soybeans are first blanched in a boiling water. Long cooking times lower the recovery of nutrients. Very short cooking times are inadequate to destroy the enzyme that causes the beany flavor.

After draining and rinsing, the blanched beans are continuously ground in a hammer mill with boiling water. The final concentration of solids in the soymilk can be controlled at this stage by adjusting the quantity of grinding water.

The soymilk is then continuously extracted from the ground slurry using the roller extractor from an adapted tofu machine. The slurry is first passed through a rotating cylindrical screen to separate the soymilk and residue. Any leftover slurry is squeezed with a roller and recycled into the intake reservoir. In the final steps, the soymilk is simmered, and then pasteurized, homogenized, and packaged.

The equipment that has been adapted for this process is widely available and relatively inexpensive.

Developing commercial products. An excellent soymilk containing more than five percent protein has already been prepared using this scaled-up method. At that concentration, about ten kilograms of dehulled soybeans are needed to produce fifty kilograms of soymilk. This product contains about ten percent total solids. That compares to cow's milk which has ten to twelve percent solids, including about four percent protein.

The okara or residue from the commercial process can be used immediately in baking or dried for later use as a high-fiber flour. The okara contains about eight percent protein on a wet basis or about forty percent on a dry basis.

This soymilk is a bland product highly suitable for making soy yogurt, soy ice cream, and other dairy analogs. Yogurt is a tasty and nutritious product made by fermenting cow's milk to form an acidic gel. Soy yogurt is made using the same culture as for regular yogurt. The steps for making soy yogurt are as follows:

- Manufacture of the soymilk.
- Formulation of the soymilk with sucrose and dextrose.
- Pasteurization and homogenization.
- Inoculation and incubation.

Soy yogurt contains less total acid than regular yogurt and should have widespread consumer appeal. The culture for soy yogurt must be carefully maintained. It should be transferred to freshly pasteurized cow's milk or soymilk about every other day. The temperature and time of incubation should be carefully controlled. Soymilk must be properly pasteurized to prevent contamination.

A small amount of added sugar promotes the fermentation. Different sugars or sugar mixtures produce somewhat different flavors in the final product.

A good-tasting ice cream can also be prepared from this soymilk and added vegetable oil. It is formulated and manufactured as in the conventional dairy ice cream process. Soy ice cream stores well and has good meltdown characteristics. This soymilk also should be nearly ideal as a base for use in commercial soft-serve machines.

The equipment used in this research could be easily adapted to a commercial soymilk operation with a volume of 100 to 200 liters per hour. With a larger roller extractor, the capacity could be expanded to about 600 to 800 liters per hour.

A soymilk plant producing 100 to 800 liters per hour would be much less expensive than available turn-key operations. Smaller processing plants that prepare pasteurized products for local rather than nationwide distribution would not need costly aseptic packaging equipment.

This cost saving could be particularly important for promoting soymilk in areas where there is a strong need for a high-protein beverage but only a limited amount of investment capital.

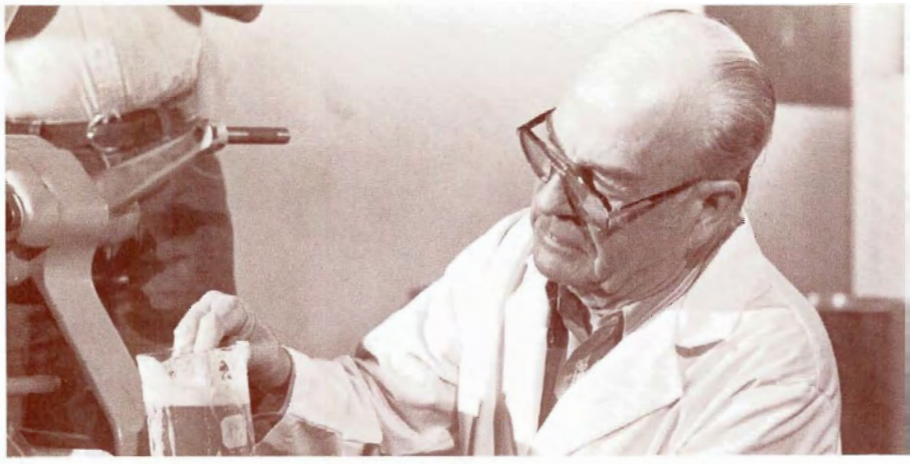
Oil From Extrusion/ Expelling Retains High Omega-3 Content

A number of recent reports indicate that dietary Omega-3 fatty acids have a benefical effect on cardiovascular diseases. Invariably, the Omega-3 fatty acids described are those types present in fish oil. Recently, some researchers have suggested that Omega-3 in the form of alfalinolenic acid, which is found in vegetable oils, may also be beneficial in the diet.

Raw soybean oil contains an average of seven to eight percent naturally occurring alfalinolenic acid. In most cases, the Omega-3 is partially destroyed during the normal refining process. The exact amount lost depends on the degree of refining.

But, with a new technique developed by INTSOY researchers Alvin L. Nelson and Wilmot Wijeratne, almost all the Omega-3 in soybeans can now be retained in a wide range of food products. The success of this method depends on combining extrusion cooking with continuous mechanical pressing of soybeans.

The extruder is used to condition the soybeans before they are processed



Utilization program leader A. I. Nelson holds a sample of oil from extruded soybeans passed once through a mechanical expeller. Research indicates that this highly stable natural oil retains virtually all of the Omega-3 factor that occurs in raw soybeans.

in the mechanical oil expeller. The soybeans remain in the extruder for a short time at high temperatures. The short cooking time destroys antinutritional agents such as the trypsin inhibitor. The Omega-3 and other important nutritional components, however, are not harmed by this process.

The highly stable oil from this process retains virtually all the Omega-3 found in raw soybeans. The content of Omega-3 in soybeans is much higher than corn, coconuts, palm kernels, and sunflowers, all of which have less than one percent. The only common food crop that has more Omega-3 than soybeans is rapeseed, which has ten percent.

On the other hand, fish oil averages about twenty percent Omega-3. University of Illinois germplasm experts, however, have already identified several soybean varieties with contents in the twelve to thirteen percent range. Through genetic engineering, it may be possible to develop new varieties for making soybean oil with Omega-3 contents equal to or higher than that of fish oil.

The soybean oil from the extrusion/expelling process could also quite easily be made into salad dressing and mayonnaise. Such familiar products containing the Omega-3 factor would certainly have much greater consumer appeal than the fish-oil supplements that are being widely marketed. Therefore, if alphalinolenic acid proves to be as effective as the Omega-3 in fish oil, the relatively high content in soybeans creates tremendous potential for marketing the oil made using this new concept.

INTSOY Plans Expanded Cooperation with Utilization Project in India

INTSOY is moving ahead with plans to expand its soybean utilization effort in India. During a recent visit to India, INTSOY director Harold E. Kauffman met with officials from the Central Institute of Agricultural Engineering (CIAE) in the state of Madhya Pradesh. Discussions centered on increasing the interchange of information and personnel and on ways to promote acceptance of new soyfoods.

In recent years, India has increased its soybean production to about 1,000,000 hectares. Because of the high demand for edible oil, more than a dozen solvent extraction plants have been constructed in the major growing areas of Madhya Pradesh.

Although large parts of the Indian population do not consume adequate amounts of protein, most of the protein meal is exported rather than used as human food. As a result, there is increasing interest in small- and medium-scale soybean processing technologies that could increase the use of soybeans as human food.

CIAE was established in 1977 to undertake research and extension activities and to apply engineering technology to increase overall agricultural productivity. Recently, the U.S. Agency for International Development(USAID) has initiated a five-year soybean processing project in collaboration with CIAE in Bhopal and G.B. Pant University of Agriculture and Technology in Pantnagar.

The soybean utilization subproject operates within the Post Harvest Research Division of CIAE. A new pilot plant and laboratory facility, which is being built with funds from the USAID project, should be completed by the end of 1987. CIAE scientists have already developed new processing equipment and a number of new soyfoods including full-fat soy flour, soy paneer, soy dal, soy snacks, and soy flakes.

The institute is located in the center of India's largest soybean growing area. Current plans are to tranfer technology developed at CIAE to the soybean growers' cooperatives in Madhya Pradesh. The cooperatives are especially interested in increasing the amount of soybeans used for human food.

Since its establishment in 1979, the M.P. State Cooperative Oilseed Federation (Oilfed) has been the driving force behind the expansion of soybean production in this region of India. Oilfed's approach is to provide soybean farmers with complete services, ranging from production inputs to help in marketing and processing.

Each of the 600 cooperatives in the federation provides the opportunity for introducing new soyfoods and processing techniques developed by INTSOY and CIAE into the rural communities of central India. If these foods and techniques are widely accepted in Madhya Pradesh, this collaborative program could serve as a model for other areas of India.

CIAE agricultural engineer Jaswant Singh recently spent eight weeks doing research at the INTSOY processing pilot plant. Current plans are for INTSOY food scientists to visit

CIAE and cooperate on improving food quality and on a study of the applicability of the combination extrusion/expelling process to Indian conditions. In addition, B. P. Ghandi, a biochemist from CIAE, will visit INTSOY during his upcoming trip to the United States.

INTSOY Hosts Visiting Chinese Scientists

INTSOY and the University of Illinois Food Science Department are currently serving as hosts for two visiting scientists from the People's Republic of China. Engineer Jai-Kun Dai and assistant engineer Yuhong Wu of the Scientific Research Institute of Food and Fermentation Industries, Ministry of Light Industry, Beijing, will spend about one year at the University of Illinois.

During that time, they will conduct collaborative research with Professor Lun Shin Wei of the INTSOY staff and Professor Ricardo Villota of the Food Science Department. The visit is sponsored by the Ministry of Light Industry and the United Nations Development Program (UNDP).

The institute's primary aims are to promote the growth of a modern food industry with traditional Chinese features and to improve the utilization of national food resources through research and development work. Dai serves as the leader of a group that specializes in exploiting new technologies for using soybeans as human food.

A particular interest has been introduction of new soymilk technology into China. As a result, China has recently begun commercial production of a soymilk with a bland flavor that is suitable for a wide range of consumers.

Another major area of interest is soy protein texturization and functionality. Research in the Food Science Department will focus on ways to improve the quality and flavor of texturized vegetable protein. Work with INTSOY will center on extrusion cooking and home and village soybean processing techniques.

University Officials Tour INTSOY Research Facilities. A.I. Nelson displays an array of innovative soybean food products for visiting University of Illinois officials, including President Stanley O. Ikenberry and members of the state Board of Trustees. The group was accompanied on its tour by John R. Campbell, dean of the College of Agriculture, and Donald A. Holt, director of the Agricultural Experiment Station.

Dates Set for Processing Course in Sri Lanka

The dates January 11 to February 9, 1988 have now been confirmed for the course "Soybean Processing For Food Uses." Instruction will take place at the Soyabean Foods Research Centre in Sri Lanka. The course is sponsored by INTSOY and the Sri Lanka Department of Agriculture in Peradeniya.

Major topics include extrusion technology, soy beverage and dairy analog processing, preparation of weaning and breakfast foods, mechanical expelling of oil, soybean protein and isolate technology, and home-scale preparations.

The choice of Sri Lanka as the course site has special significance because of the country's remarkable progress in the past decade on the promotion of soybeans as human food. The course therefore offers a unique opportunity to share Sri Lanka's experience in establishing a soybean industry and to gain valuable insights into the opportunities and problems confronting similar efforts in developing countries.

The course fee of US$2,000 per participant covers training costs, instructional materials, and transportation during the course. International travel to and from Sri Lanka is not included. Each participant should bring at least US$1,000 to cover living expenses during the course.

Names and biographical data must be submitted before November 15, 1987. Anyone who wishes to reserve a place in the 1988 course in Sri Lanka or wants additional information should contact: INTSOY, University of Illinois at Urbana-Champaign, 113 Mumford Hall, 1301 West Gregory Drive, Urbana, Illinois 61801, USA; or Mr. Cecil Dharmacena, Soyabean Foods Research Centre, Department of Agriculture, Gannoruwa, Peradeniya, Sri Lanka.

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INTERNATIONAL SOYBEAN PROGRAM

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University of Illinois
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College of Agriculture

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INTSOY Research Focuses on Green Soybeans as Commercial Frozen Vegetable

A major focus of current INTSOY research is the development of immature green soybeans as a commercial frozen vegetable. Certainly no other vegetable can match soybeans for nutritional value. Green soybeans, for example, have an average of 12 percent protein on a wet basis, compared to 7.6 percent for lima beans and 5.4 percent for peas. An excellent source of essential vitamins and minerals, green soybeans also contain the Omega-3 factor.

Green soybeans are already popular as a food in the Orient. In Japan, they are served in the pod as a snack food. Frozen soybeans in the pod are regularly imported to Japan from Taiwan. Green soybeans are even imported into the United States to meet the demand from Oriental speciality foodmarkets.

The potential for this product, however, has been largely untapped outside the Orient. Nevertheless, numerous highly positive taste tests of green soybeans cooked after being frozen indicate that the product could have wide appeal eaten alone, used in frozen dinners and vegetable mixes, or marketed as a specialty Oriental food product.

The main obstacles to the development of green soybeans as a major commercial product in the United States are problems in harvesting and breaking open the pods during processing. In the Orient, the green soybeans are generally picked by hand or with simple harvesting equipment and are frozen in the pods. These methods, however, are inadequate for harvesting and processing green soybeans on a commercial scale of several hundred million kilograms.

Developing new harvesting and processing techniques. As a result, research at INTSOY has centered on developing improved harvesting and processing techniques. The results of 1986 field trials conducted in cooperation with the Joan of Arc division of Pillsbury showed that available green bean picking equipment could easily pick 60 to 70 percent of the immature beans in a single pass. This rate compares closely to the results in commercial pea, green bean, and lima bean harvesting operations.

Ordinary field varieties, rather than the vegetable types, were found most suitable for commercial harvesting. Major difficulties still remained because the equipment used in these trials does not separate the seeds from the pods during harvesting.

After harvesting, the pods were cleaned of debris, washed, blanched in boiling water for at least four minutes, and cooled with water. The pods could then be opened to release the seeds with much less applied force.

New field trials. Most importantly, preliminary results from recently completed field trials indicate that immature green soybeans can also be effectively harvested using a combine-type green bean picker. The model

Recent field trials have confirmed that a combine-type green bean picker can effectively harvest and depod immature green soybeans in the field. This research at a test plot near Belvidere, Illinois, was carried out in collaboration with the Green Giant division of Pillsbury.

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SP 6710GB picker, developed by the Frank Hamachek Machine Company of Kewaunee, Wisconsin, not only cuts and harvests, it also depods and cleans the beans in the field, thereby eliminating most of the processing problems encountered with ordinary harvesting techniques.

Trials with the Hamachek combine were conducted in collaboration with the Green Giant division of Pillsbury on a one-hectare test plot near Belvidere, Illinois. Test runs were carried out in mid-August 1987. Each session included two passes covering four 75-centimeter rows of soybeans over a distance of about 90 meters.

The soybean varieties used in the trials were Hack and BSR 201, which are both standard field varieties from Maturity Group II. Harvesting took place about 80 days after planting, during the R6 stage when the beans on the four uppermost nodes almost filled the pods. Moisture content of the beans measured from 68 to 72 percent.

Depending on the variety and the planting date, green soybeans can be harvested from 60 to 90 days after planting. The beans are optimum for harvesting during a one-week to two-week period. This compares with a harvesting period of only a few days for peas.

The average yield for these preliminary runs was about 2,000 kilograms per hectare. The Hamachek combine operated efficiently with only minimum modifications to the screens and blowers. Using a smaller screen size undoubtedly would increase the yield.

The combine effectively removed all stalks, leaves, and pods, and left only small debris mixed in with the seeds. After removal from the field, the beans were cleaned in a reel-rod washer, blanched, recleaned, and quick-frozen at minus 40 degrees C.

Several more field trials will be required to perfect adjustments on the harvesting equipment. Further work is needed to evaluate different varieties and to determine the best ways to store and package the beans. Marketing and economic studies are also needed before the product is ready for widespread production.

More than 60 people attended a recent soybean processing and utilization workshop in Zambia. During almost a week of training, participants gained extensive "hands-on" experience on ways to incorporate soybeans into local food dishes.

Zimbabwe and Zambia Move Ahead on Expanded Use of Soybeans

Recent trips to Africa by INTSOY director Harold E. Kauffman and utilization program leader Alvin I. Nelson revealed an unprecedented surge of interest in expanding the use of soybeans for both animal feed and human food. Zimbabwe and Zambia in particular have had tremendous success increasing the use of soybeans.

In Zimbabwe, the soybean sector of the agricultural economy continues to grow despite one of the worst droughts on record. Soybean production, which leads the oilseed sector, reached a record of slightly more than 100,000 metric tons in 1986-1987. This level of production compares with 82,000 metric tons in the previous year, when weather conditions were much better.

The large increase in soybean production was stimulated by higher government prices, which encouraged a shift from maize. All the soybean oil and most of the soybean meal are consumed locally.

The driving force behind the expansion of the soybean industry has been the Cooperative Oilseed Producers Association (COPA). At the annual meeting in Harare, members of COPA predicted a crop for next year of 125,000 metric tons. COPA is intensifying the search for new processing, utilization, and marketing innovations. Growers especially want to increase the use of soybeans in food.

Nutresco Foods Ltd. in Harare has recently begun using a new INSTA PRO 600 extruder to make textured vegetable protein and other soyfoods. Considerable markets for extruded products already exist both within Zimbabwe and throughout the region. The company expects a market in the country for about 20 metric tons of soy meat extenders alone.

Several Zimbabwean companies have expressed strong interest in the new extrusion/expelling system developed by INTSOY researchers. This system would allow decentralization for some of the processing and marketing of edible oil and high-protein meal.

Zambia emerges as soybean processing leader. In Zambia, the soybean industry is one of the few bright spots in the economy. During the past five years, soybeans have developed into an established crop. Production has increased from about 5,000 hectares in 1982 to more than 25,000 hectares this year.

Production was down this year on large commercial farms because of the drought. But, production on the nearly 13,000 small farms coordinated by the LINT Company of Zambia has increased to more than 7,000 metric tons. Most of these farms are located in the north where the drought has been less severe than in the south. Predictions are

that, because of recent price increases, overall soybean production could reach more than 100,000 metric tons by 1990.

Soybean utilization work in Zambia began with the training of several home economists at INTSOY short courses at the University of Illinois and in Sri Lanka. The extension wing of the Ministry of Agriculture and several private volunteer organizations have further promoted home soybean use.

A previous visit in 1985 by Nelson helped spark the rapid introduction of extrusion cooking by several private companies. This action, in turn, led to the widespread local marketing of full-fat soy meal and the introduction of several foods fortified by soy.

The commercial processors are now rapidly expanding into new product areas. The availability of these new products, along with improvements in the quality of traditional products, has opened up many additional markets for soyfoods.

The Lee Yeast Company in Lusaka has purchased two INSTA PRO 600 extruders and recently ordered two more extruders. The company is selling full-fat meal for animal feed and incorporating soy flour into bread.

The Soy Nutrients Company is operating four INSTA PRO extruders and has ordered one more. The company is making full-fat meal for animal feed and has begun producing a soy meat extender. The market for the meal is already very strong, with a production level of about 30 to 40 tons per day for animal feed. Additional production of one ton per month is used for meat extenders and bread supplements.

National Milling Limited, the largest milling company in Zambia, has been pleased with the animal feed stocks obtained from Lee Yeast and Soy Nutrients. National Milling is particularly anxious to use soy in maize mealy meal and bread. The extrusion/expelling process is of special interest because the resulting defatted meal would be ideal for such products. INTSOY recently has sent samples of partially defatted meal for testing in Zambia.

Interest is also very high in Zambia for increasing the use of soybeans in the home. A soybean recipe book was recently published and has been enthusiastically received. The home economics section of the Ministry of Agriculture is particularly interested in expanding its training effort.

Recently, a major soybean processing and utilization workshop was held at the the University of Zambia. The first part of the session covered new commercial-scale processes and uses. The second concentrated on home and village soyfood preparation.

A. I. Nelson and Wilmot Wijeratne from INTSOY, Hea-Ran Ashraf from Southern Illinois University, Karl Weingartner from the International Institute of Tropical Agriculture (IITA) in Nigeria, and Ellen Jayawardena from the Soyabean Foods Research Centre in Sri Lanka served as guest instructors. They conducted the workshop in collaboration with a number of soybean experts in Zambia, including Fred Javaheri, Joe Temba, Joseph Malwe, Kathryn Siandweza, and Chabala Malwe.

Cooperative Efforts in Nigeria Aim to Increase Soybean Use Across Africa

INTSOY is currently collaborating with the International Institute of Tropical Agriculture (IITA) in Ibadan, Nigeria on ways to expand soybean processing and use throughout Africa. The Nigerian government, working in collaboration with IITA, has also provided essential research guidance for the current surge in new soybean production and processing technologies in Nigeria.

Soybeans were first introduced into Nigeria about a half century ago. Much of the production is concentrated in the northern states of Benue and Kaduna. The most widely consumed soyfood in the country is soybean dawa-dawa, a fermented and dried product that is sold as a wafer.

Dawa-dawa, also known as iru in some areas, is traditionally made from the seed of the locust bean tree. Soybeans, however, have proved a highly nutritious and inexpensive substitute for locust beans. According to a 1984 survey by IITA, about 60 percent of dawa-dawa producers use soybeans, while another 20 percent use a combination of soybeans and locust beans.

Dawa-dawa is used to flavor soups, stews, and sauces. After soaking in water, the wafer is crushed and added to dishes during cooking. Another method of using the dawa-dawa wafer is to pound the dry wafer and add it to dishes as a powder.

In the soybean marketing center of Kafanchan in southern Kaduna state, groups of women operate cottage industries that prepare commercial quantities of soybean dawa-dawa. The product is purchased by traders, who sell it throughout Nigeria and as far away as Cameroon, Chad, and Niger.

Soybeans are relatively new in the southwestern part of Nigeria. There are signs, however, of rapidly increasing interest. IITA staff in collaboration with the national program last year held utilization training sessions that attracted more than 180 participants in Ondo state. Other training sessions at 34 villages in Oyo state and at the Kersey Children's Home near Ogbomosho also drew strong attendance.

About three years ago, the children's clinic at the Kersey Home started using soymilk and soy-fortified weaning foods to combat the childhood malnutrition known as kwashiorkor. Soybeans proved to be the most effective and least expensive source of high-quality protein. The clinic now uses almost two tons of soybeans a month.

Follow-up studies indicated that most of the mothers of ex-patients at the clinic continued to cook soybeans at least once a week in their homes. Due to the rising demand for further training, the Baptist Hospital and the Women in Development Center at Ogbomosho have established regular sessions near the Kersey Home. By 1986, more than 3,000 farmers in Oyo State were growing soybeans on small plots totaling 1,000 hectares.

Commercial processing in Nigeria. In the commercial sector, several new processing methods and products have been introduced in recent years. Soy

meal for the rapidly growing poultry industry is now the most important commerical soy product. A number of companies, however, are moving into the production of soymilk, high-protein soyfoods, and edible oil. Both Food Specialities Limited and Smalltree Nigeria Limited are increasing the use of soybeans in infant and breakfast cereals.

During a single six-month period in 1987, more than 30 businesses and individuals contacted IITA for technical advice on opening or expanding soybean processing operations. Planned processing facilities ranged from small-scale roasters for preparing animal feed to large-scale solvent extraction plants.

Extrusion cooking in particular has recently had an increased impact in Nigeria. Local processors have already purchased at least four INSTA PRO extruders. These purchases have allowed expanded production of poultry feed and full-fat soy flour for human consumption. The new local processing capacity has been especially important because of government restrictions on importing soy products.

Soybean production has more than doubled in the last five years in response to the growing demand and the complications caused by the lack of foreign exchange to import soybean meal. The 1987 crop is estimated to be at least 125,000 metric tons. Much of the production increase on both large and small farms resulted because of the current high cash price.

INTSOY's experience working with IITA clearly indicates that expansion of soybean use in Nigeria and throughout Africa will require the introduction of new products, processes, and equipment adaptable to African village-level operations, cottage industries, and small-scale processing enterprises.

Further work is also needed on food combinations that fit African tastes and cooking methods. In addition, there is an urgent need for increased training of home economists, extension workers, and other rural development workers on improved soybean processing and home use.

Swaziland Businessman to Open Soybean Extrusion Operation

Following a December 1986 visit to the INTSOY pilot plant, Dale Allen, a commercial farmer in Swaziland, is moving ahead with plans to install an extruder for processing soybeans. With the purchase of an INSTA PRO 600 extruder, he will become the first commercial soybean processor in Swaziland.

Allen hopes to market both animal feed and soy-fortified flour. A key factor in the decision to move into soybean processing is the strong demand for high-protein meal for the rapidly growing poultry industry. Another important element is the keen interest in soyfoods as a source of much needed protein in the local diets.

The increased interest in soyfoods can be traced back to 1982 when two participants from Swaziland attended the INTSOY processing short course. A survey at the time indicated that 30 percent of the children less than five years old suffered stunted growth because of protein deficiencies. As a result, the returning participants began promoting the use of soybeans through the home economics section of the Ministry of Agriculture.

Later the cropping systems program of the U.S. Agency for International Development (USAID) began working with the home economics section to promote use of soybeans in the rural areas. Products which are being promoted include roasted soybeans and soy-fortified mealy meal.

CARDI Project Plans to Introduce Soy Processing Equipment in Belize

S. K. Sinha of the Caribbean Agricultural Research and Development Institute (CARDI) and Jack Bachofer of CHEMONICS International Consulting recently conferred with INTSOY researchers on ways to increase soybean use in Belize. Production in the country is currently limited to about 25 hectares of farmers' demonstration plots near the experiment station at Belmopan. Several local farmers, however, are planning to go into commercial production in 1988.

A key objective for the Commercialization of Alternative Crops Project sponsored by CARDI is the introduction of small- and medium-scale soybean processing technologies for production of feed for the swine and poultry industries and full-fat flour for human consumption. One processor is currently using simple roasting to produce animal feed and meal for a local flour mill.

A large market already exists for the few available soy products. There is strong interest in expanding production of current products and introducing new products such as edible oil and flour for tortillas. Plans are underway to work with a local businessman to purchase an improved soybean roaster.

The project is strongly considering the introduction of an extruder to produce full-fat soy meal and a variety of maize-soy products. As demand increases, the extruder could be coupled with a mechanical expeller for the production of defatted soy meal and badly needed edible oil.

A major concern, however, is the extremely high cost of electricity and diesel fuel in Belize. One possible plan is to offset the high power costs by marketing an array of value-added soy products.

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INTSOY

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INTSOY Plans Joint Research to Promote Use of New Technologies

To promote the use of new soybean processing technologies in developing countries, INTSOY has initiated a major collaborative research effort with BAR Export/Import Incorporated. This new company plans to market a full range of medium-scale soybean processing systems based on technology developed by INTSOY. Products made with this equipment will range from high-protein feed for livestock to soymilk and soy flour for human consumption.

INTSOY will work with BAR Export on a variety of joint research activities spanning a 14-month period through late fall 1988. This work coincides with the closing of the INTSOY pilot plant during the $1.4 million remodelling project underway at the University of Illinois' Agricultural Bioprocess Laboratory.

The collaborative research conducted at the BAR Export facilities initially will focus on refining the continuous commercial process that combines extrusion cooking with a mechanical oil press to produce partially defatted soy meal and edible oil. Later efforts will include developing of a medium-scale pilot plant for production of soymilk, soy yogurt, and soy ice cream. The BAR Export facility will also serve as a major demonstration and training center.

BAR Export is one of five entrepreneurial businesses launched under the agribusiness incubator program at the University of Illinois. It recently moved from the Supported Research Incubator Building at the University to larger commercial facilities north of the campus.

The company was founded by Ramlakhan Boodram, who is originally from Trinidad. His partner in the expanded operation is Indiana businessman David Gunsaullus. Richard Nelson will serve as the company's vice president of operations. BAR Export expects to have a fully operational pilot plant in place by early spring 1988.

BAR Export president Ramlakhan Boodram confers with INTSOY utilization program leader A. I. Nelson during cooperative trials at the BAR Export research and training facilities in Urbana, Illinois. The focus of this collaborative effort is refinement of new medium-scale, commercial soybean processing techniques developed by INTSOY.

Marketing appropriate technology systems. The company plans to focus on appropriate processing technologies that are accessible to as many developing countries as possible. These techniques will cover both wet and dry processing of soybeans. The wet processing systems are aimed at low-cost production of a bland-tasting soymilk suitable for a wide range of consumers.

However, BAR Export initially will concentrate on five different dry processing systems. The least expensive is a basic system that includes an extruder and simple added equipment such as a mill, a cooler, and a cutter. It will also offer a basic oil extraction system suitable for all traditional oil-bearing crops. This unit consists of an expeller with a roasting pan and a filter press.

Two additional systems are based on the extrusion-expelling technology developed by INTSOY. These will include the basic extruder and expeller, as well as various extra items such as mixers and oil degumming tanks. The company also will offer a simple soybean cleaning and dehulling system. In addition, Bar Export plans to develop a simple kit for making soybean foods in the home.

Most systems are priced from about $20,000 to $100,000. The cost covers all equipment needed to produce a finished product but excludes packaging expenses. BAR Export, however, will provide direct assistance in developing appropriate packaging, labeling, and product formulations.

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Potential customers range from governments and cooperatives to individual entrepreneurs and farmers. They will be able to purchase equipment separately or as a prefabricated processing unit that can be shipped on a skid and set up nearly anywhere in the world in a matter of days. The company also will provide full back-up support, from technical assistance to training and management help.

Price quotations for equipment are already pending for a number of countries, including Nigeria, Zambia, Tanzania, Zimbabwe, Colombia, Trindad, Jamaica, and Sri Lanka. The company is also marketing extruder and extrusion-expelling systems to farmers' cooperatives and grain elevators throughout Illinois and the midwestern United States.

Ellen Jayawardena of the Soyabean Foods Research Centre in Sri Lanka demonstrates techniques for home cooking of soybeans to trainees at the recent workshop in Zambia. The sessions held at the University of Zambia attracted nutritionists, home economists and extension workers from throughout the country.

Soybean Utilization Workshop in Zambia Attracts Almost 100 Participants

As part of a major training effort in Africa, INTSOY utilization program leader Alvin I. Nelson and research associate Wilmot B. Wijeratne played a lead role in organizing and presenting a major soybean utilization workshop in Zambia. The two separate sessions on commercial soybean processing and home and village use of soybeans attracted nearly 100 participants from government agencies, the University of Zambia, and private industry.

The workshop was jointly sponsored by the government of Zambia, the Zambia Agriculture Research and Extension (ZAMARE) Project, the Canadian International Development Agency (CIDA), and private industry sources in Zambia. Fred Javaheri, national soybean coordinator, acted as workshop coordinator. Joe Temba, head of the Crop Sciences Department at the University of Zambia, arrarged activities at the university, and Oval Myers, Jr. of the ZAMARE Project served as the workshop chairman.

The session on "Industrial Processing and Use of Soybeans in Zambia" opened on October 6, 1987, at the Shell Oil Company meeting room in Lusaka. The morning activities included lectures and video tape presentations by A. I. Nelson of INTSOY and Karl Weingartner, food scientist from the International Institute of Tropical Agriculture (IITA). The presentations focused on dry extrusion processing of whole soybeans for both human food and animal feed.

During the afternoon, the group moved just south of Lusaka to the Lee Yeast Company facilities. The highlight was a demonstration of the new technique that combines extrusion cooking with a mechanical oil expeller to produce high-quality edible oil and food-grade defatted meal.

The one-day workshop drew an overflow crowd of more than 50 people from both industry and government. Participants showed a strong interest in all aspects of commercial soybean utilization. Throughout the session, they asked specific technical questions, which produced an important interchange of practical information.

Workshop on home and village use of soybeans. The commercial session was followed during October 12 to 16, 1987, by sessions on home and village use of soybeans for human food. The five-day workshop at the University of Zambia attracted almost 50 home economists, nutritionists, and field extension workers. The auditorium of the Animal Science Department and the laboratories of the Crop Science Department provided nearly ideal settings for the gathering

The workshop was divided into three parts: student interaction, lectures, and practical demonstrations. In the student interaction sessions, the participants spoke about their home areas in Zambia and the impact that increased use of soybeans could make in their communities. The lectures covered the local food situation, soybean use in Zambia, and the role of soybeans in improved nutrition.

Wilmot Wijeratne of INTSOY, Ellen Jayawardena of the Soyabean Foods Research Centre in Sri Lanka, Karl Weingartner of IITA, and Hae-Ran Ashraf of Southern Illinois University served as guest instructors for the sessions. Lecturers from Zambia included S. Chintu, K. Siandwazi, S. Mabuya, M. Mwala, and J. Temba.

Several Zambian government and university soybean experts, including B. Luozhya, R. Dadson, R. Kamona, and J. Mulila, served as local chairpersons for the various sessions. Russell Mulele, director of agriculture, and Bharti Patel, deputy director of agriculture, presented the opening and closing remarks respectively.

More than a third of the workshop time was spent on practical demonstrations and hands-on student participation. Jayawardena was in charge of the overall soybean cooking demonstrations, while Ashraf concentrated on the preparation of traditional Zambian recipes.

The two lab sessions were run concurrently to accommodate all the participants and to allow them to be involved in actual cooking. The groups were rotated so that everyone spent time in each of the lab sessions.

The activities featured displays of soybean meat substitutes, dry dehulling, soy curry, tofu relishes, soy protein isolates, defatted and full-fat flour, soymilk, and various types of roasted soybeans. Group members showed special interest in simulated meat products.

The group was divided into four parts to represent the northwestern, central and southern, eastern, and copperbelt provinces. Scholastica Mabuya acted as the local assistant and presented demonstrations of how to make soy munkoyo and soy sausage. On the last day, participants developed and prepared new soy-based foods compatible with Zambian tastes and methods of preparation.

All the traditional foods contained soybeans as an additional ingredient or as a substitute for ground nuts or meats. The recipes included porridge, nshima, vegetable relishes, meat relishes, soy nut crunch, and banana soymilk.

The program provided a strong balance of instruction and practical experience in preparing soyfoods. A short test at the end of the session showed that participants clearly understood the basic concepts used to prevent off-flavor, inactivate antinutrititional factors, and reduce cooking time.

Results of the workshop indicated there is great potential for using soybeans in the preparation of the Zambian staple food called nshima. This is a gruel prepared daily from corn meal. The corn meal, also known locally as mealy meal, is centrally processed for retail sale to consumers. This centralization creates the potential for efficient and widespread fortification with soy protein.

Tests carried out at the National Milling Company of Zambia confirmed that mealy meal could be fortified with 15 percent low-fat soy flour without affecting the acceptability of the nshima made from the blend. Officials were optimistic that fortified products could be successfully marketed if the needed soy flour was available.

In addition, the workshop has sparked strong interest in a long-term soybean utilization program that would include the use of mobile units to carry demonstrations into the field. Housewives would be trained how to properly use soybeans in the home preparation of nshima. Further work is also needed to insure a better supply of high-quality soybeans for making human foods.

A. I. Nelson of INTSOY explains proper procedures for operating extrusion cooking equipment to participants at the workshop on commercial soybean processing. The demonstrations at the Lee Yeast Company outside Lusaka also included instruction on the use of a mechanical oil expeller in combination with an extruder.

Extruded Soybeans Produce Pork Higher in Omega-3

Consumers may soon be able to buy healthier pork with three or four times as much Omega-3 fatty acids as standard ham and loin cuts. According to new research by INTSOY, this dramatic increase in Omega-3 can be accomplished simply by feeding pigs a diet of 20 percent extruded soybeans.

In the study conducted by Professor Robert Easter from the Department of Animal Science at the University of Illinois, a control group of pigs was fed a normal diet of corn and solvent-extracted meal, while another group received a diet of corn and extruded whole soybeans. The feeding took place during the pigs' finishing period from about 54 kilograms to market weight of about 110 kilograms.

Tissue samples were taken at slaughter and analyzed for Omega-3 content. The laboratory work by INTSOY research associate Tsao-Ming Wei showed that the Omega-3 content for various cuts of meat from pigs fed extruded soybeans was consistently 250 to 400 percent higher than that from the control group, which received the standard diet of corn and solvent-extracted meal.

For example, in the ham muscle, pigs from the control group had about .20 percent Omega-3, compared to about .50 percent for pigs on a diet of extruded soybeans. The loin meat from the control group showed only about .08 percent Omega-3. The amount, however, increased to nearly .35 percent for the group that was fed extruded soybeans. For subcutaneous fat, the level increased from about .30 percent to 1.2 percent.

The key to the process is the tendency of pigs and other nonruminant animals to deposit dietary fat in the tissue. Changes in the diet, therefore, are usually reflected by changes in the tissue. In this case, the result of feeding a diet of extruded soybeans was a

marked increase of Omega-3 in the tissues.

The source of this Omega-3 is the 7 to 8 percent that occurs naturally in soybeans in the form of alpha linolenic acid. Earlier work by INTSOY researchers showed clearly that virtually all this content is retained in the fullfat soybean meal processed by commercial extrusion cooking.

The Omega-3 from soybeans, however, occurs in lesser amounts and is slightly different in composition from that found in fish. The exact amount of Omega-3 needed in the human diet remains a subject of controversy. But, if the quantity consumed is important, pork is clearly the winner over fish in the average diet. Recent statistics show that people in the United States eat an average of 65 pounds of pork per year, compared to only 14 pounds of fish.

Moreover, there are a number of ways to further increase the level of Omega-3 in pork. In fact, Easter is convinced that the pigs' diets can be adjusted to produce whatever levels nutritionists determine are best for human health.

A major possibility is to couple this technique with new repartitioning agents that reduce the amount of fat in the pig's carcass. The result should be less overall fat content and a postitive change in the composition of the remaining fat by replacing much of the saturated fat content with the healthier Omega-3 fatty acids.

According to Easter, this technique could play a major role in improving the consumer image of pork in the United States. Major processors may even use it as marketing tool. This change, in turn, could lead eventually to the appearance of new designer cuts of pork in the supermarket meat case.

Most importantly, producers can use this technique easily by simply substituting extruded soybeans for normal defatted soybean meal during the finishing period. No major changes in feeding technology are needed. Producers can use the same corn-based rations, the same feeding systems, and the same mixing procedures that they would normally use.

As a result, for farmers who find an economic advantage in extruding their own soybeans, the increase in Omega-3 would be an extra that essentially costs nothing

Extrusion And Oil Expelling Project Planned for Community in Tanzania

The Njombe District Council and the Soytec Research Foundation of Ferndale, Michigan are moving ahead on plans for a community-based extrusion cooking and oil expelling enterprise in the Tanzanian city of Njombe. The project, which is awaiting final funding by UNICEF, also would include an extrusion-expelling pilot plant at Tanzania's Sokoine University of Agriculture. Technical support will be provided by consultants from Soytec, BAR Export, INSTA PRO, and INTSOY.

The goal of the project is to increase nutritional education and to expand processing of sunflower seeds and soybeans throughout the Njombe District. The research operation at Sokoine University will focus on processing local crops into extruded food products and determining the most acceptable food tastes and textures. The private, community-based facility at Njombe will emphasize practical training and production of livestock feed and human food.

Implemenation of the project will be carried out in cooperation with the Njombe District Trust and the Njombe Development Corporation. Initial work will center on development of sound marketing and management principles. Additional plans call for establishing several commercial food and livestock feeding operations, including a restaurant, a demonstration center, and local distribution networks.

The proposal further provides for assistance in gathering data on existing social, economic, and nutritional problems in villages throughout the district. Emphasis will be placed on including local women in all phases of planning and implementing the project. It is hoped that the scope of the project eventually can be expanded to include towns and villages in the neighboring Iringa Region.

INTSOY Presents Exhibit At Major Soybean Conference

At the request of the Land of Lincoln Soybean Association, INTSOY recently participated as an exhibitor at the annual Corn-Soy Conference in Peoria, Illinois. The event, which was held November 23-24, 1987, at the Peoria Civic Center, attracted several hundred soybean producers and processors from across the midwestern United States.

The INTSOY display was located in the main "Soy World" exhibit area adjacent to displays from the American Soybean Association and from the Archer Daniels Midland Company. The exhibit provided an opportunity for visitors to sample a wide range of innovative soyfoods developed by INTSOY. Video tapes of the research on soymilk, extrusion-expelling, and immature green soybeans ran continuously during the exhibition.

The presentation drew especially strong interest from soybean farmers interested in producing livestock feed with the extrusion and extrusion-expelling systems. A number of producers, as well as representatives from farmers' cooperatives, followed up by contacting the INTSOY office for additional information. Several already have visited the campus research facilities and are seriously considering buying the extrusion-expelling system developed by INTSOY.

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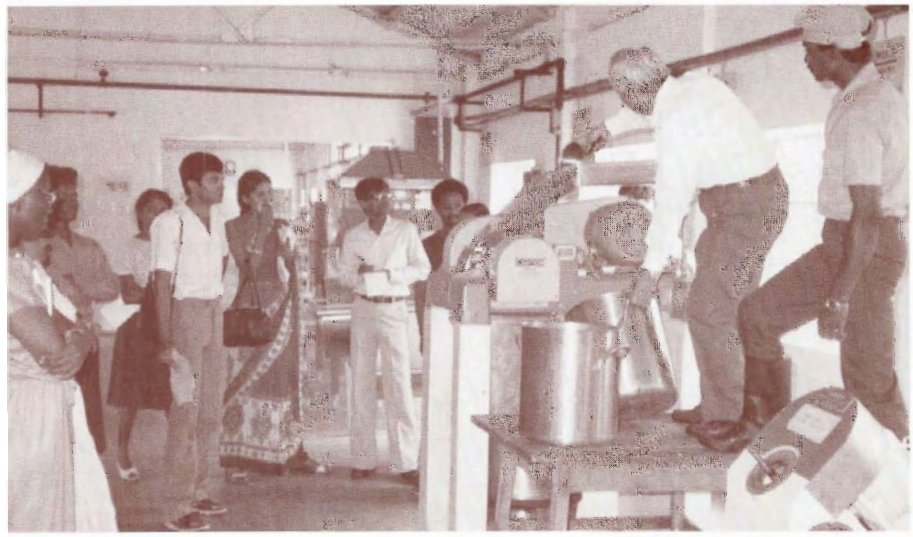
Processing Short Course in Sri Lanka Draws Participants from Nine Countries

A total of 21 people from nine countries attended the recent INTSOY-sponsored processing short course in Sri Lanka. The home countries of the participants included Nigeria, Kenya, Nepal, Pakistan, India, Bangladesh, Ethiopia, Sri Lanka, and the United States. The course, which covered all major aspects of soybean processing for food uses, was held from January 11 to February 11, 1988, at the Soyabean Foods Research Centre in Peradeniya.

INTSOY Research Associate Wilmot B. Wijeratne acted as course coordinator. INTSOY staff members Alvin I. Nelson, Tsao-Ming Wei, and Jane E. Gleason, along with Food Science Professor Lun Shin Wei of the University of Illinois, served as visiting instructors during all or part of the month-long session.

Cecil Dharmasena, the Sri Lankan national soybean coordinator, handled local arrangements for the course. Ellen Jayawardena and Fauzia Hewavitharana served as the principal instructors from the staff of the research center. Several other Sri Lankan representatives from government, industry, and universities participated as guest lecturers.

The course covered both small-scale industrial processing and home preparation of whole soybeans as human food. Major topics discussed were extrusion technology, soy beverage and dairy analog processing, preparation of weaning and breakfast foods, mechanical expelling of oil, and soybean protein technology.



L. S. Wei, University of Illinois Food Science professor, shows a group of trainees in the INTSOY processing short course how to make soymilk by wet grinding blanched soybean cotyledons.

The choice of Sri Lanka as the course site allowed participants to gain valuable insights into the opportunities and problems confronting soybean programs in developing countries. Four days were spent on field trips that featured visits to soybean farms, a full-fat soy flour factory, a solvent extraction plant, a community feeding program, and several small-scale soybean processing facilities.

Fourteen of the trainees attended full-time; seven participated part-time. Attendance was reduced somewhat because of several last-minute cancellations due to concerns about the political situation in Sri Lanka. The final roster, however, showed a diverse group that included representatives from government, universities, private businesses, and public-sector industries.

The backgrounds of the participants covered a wide range of disciplines: food science, agronomy, business management, nutrition, home economics, and extension education. Those with specific interests received independent instruction and had the opportunity to do additional work after regular hours and on the weekends.

Building on past experience. Several of the participants already had experience in established soybean businesses and extension programs. Mojib Ahmed, for instance, owns two restaurants and operates Mojib's Low-Cost Food Programme in Karachi, Pakistan. In

recent years, he has developed a strong interest in using soyfoods to improve the health and nutrition of poor people in the city. Ahmed is preparing a proposal to form a private foundation that would promote the benefits of soybeans throughout the country.

Epafuladito M. Kiwanuka operates Ken-Soya Foods Limited in Nairobi, Kenya. This company makes full-fat soy flour by milling dry roasted soybeans. Kiwanuka brought samples of his products for analysis and took advantage of several opportunities to receive individual instruction in extrusion and oil expelling operations. He now is moving ahead with plans to purchase an extruder for his business.

The FAFFA Foods Plant in Addis-Ababa, Ethiopia, was represented at the course by Yehualashe T. Demissies and Kassech Abegaz Mersha, who are both quality controllers. The food plant is an independent company sponsored by the Ethiopian government and the Swedish International Development Authority. In collaboration with the Ethiopian Nutrition Institute, it produces a low-cost, protein-rich supplementary food product that is used primarily for infants and young children. The product contains 18 percent defatted soy flour. Sales have recently reached 2,000 metric tons per year.

Somendra Thapa from Indreni Soyabean Industries in Kathmandu, Nepal, came to the course with a special interest in the manufacture of soymilk and dairy analogs. His company is establishing a large-scale soymilk facility based on technology developed by Alfa-Laval. His major concern is finding ways to utilize the okara, which is a byproduct of soymilk production.

The Institute of Agricultural Research and Training (IART) in Nigeria was represented at the course by Siddi Osho, a food technologist, and Margaret Ogundipe, a home economist. IART has developed a collaborative program with the International Institute of Tropical Agriculture to promote increased home and community use of soybeans as food. Osho and Ogundipe have both encountered continuing problems with off-flavor in soymilk made in the home. They took strong interest in the new INTSOY soymilk process and spent extra time working with staff members on home soyfood preparations.

Another course participant was Judith Edmister, a food scientist from the Mennonite Central Committee (MCC) in Dhaka, Bangladesh. MCC has worked on promoting home consumption of soybeans as a means to overcome the steady decrease in protein consumption in Bangladesh. Recently MCC has focused on the problems of soybean marketing and utilization. The goal is to broaden the appeal of soybeans as a human food and to remove its stigma as a "poor man's food."

A. M. Y. Jasmine de Silva, assistant director of the Sri Lanka Industrial Development Board, also attended the course. Her work involves aiding the establishment of small-scale, agribusinesses through technology transfer. The Development Board specializes in identifying promising technologies, in preparing technical and financial feasibility studies, and in facilitating loans for prospective entrepreneurs. As a result of participating in the course, she identified numerous possibilities for promoting small-scale soybean processing businesses.

Other full-time participants were: Ayodeji A. Ayorinde, agronomist with UNICEF in Lagos, Nigeria; Gudaru Sarojini, associate professor in foods and nutrition at the A. P. Agricultural University in Hydrabad, India; Marie-Claude Petion, graduate student at the University of Utah in the United States; G. G. S. Gunasekara, assistant lecturer at the University of Peradeniya in Sri Lanka; and Deepa Dias Kadawatha Arachchi, research officer at the Agricultural Research Station in Kundasale, Sri Lanka.

Part-time participants—all from Sri Lanka—included: R. Rupasinghe, S. Ratnayake, S. F. Hussain, D. B. T. Wijerantne, S. Ekanayake, T. S. S. Peiris, and S. Thaha.

Assessing the results. INTSOY instructors rated the entire group as one of the best for any of the processing short courses. As for the participants themselves, Mojib Ahmed summed up their feelings during an address at the closing ceremonies:

"I would like to thank the people of Sri Lanka for their open-hearted hospitality and goodwill which was extended to us in abundance wherever we went. I would like also to say on behalf of all the participants that our initial ideas and expectations with regard to the benefits of this course have been more than achieved.

We are going back now much better equipped to identify and tackle specific situations in our different countries. The added benefit of this course being held this year in Sri Lanka is that the problems and solutions being experienced in Sri Lanka relate to a certain extent to the Asia/Africa region in terms of scale and specific situation."

INTSOY Co-Sponsors Illinois Forum on Full-Fat Soybeans in Swine Nutrition

INTSOY recently served as co-sponsor of a major forum on the use of full-fat soybeans in swine production. The one-day session, which was held March 25, 1988, at the University of Illinos, drew together more than 70 leading business people, swine and soybean producers, and university researchers. Participants came from as far away as Minnesota and Ohio to exchange views and review the impact of new research developments.

Besides INTSOY, the other sponsoring groups were: the Land of Lincoln Soybean Association; the INSTA PRO Division of Triple-F, Inc.; BAR Export/Import, Inc.; and the Eastern Illinois Pork Producers Association. Bill Tiberend, executive director of the Land of Lincoln Soybean Association, served as moderator for the meeting. John R. Campbell, dean of the University of Illinois College of Agriculture, outlined in opening remarks the

University's achievements in soybean research.

Defining the role of full-fat soybeans. Harold Kauffman, director of INTSOY, started the morning panel presentations with a discussion of INTSOY's mission and its implications for farmers in the United States. He pointed out that INTSOY is a unique program that encourages research on alternative processing techniques and provides an opportunity to keep current on developments around the world in soybean processing.

According to Kauffman, INTSOY's research focus on using extrusion and other medium-scale techniques to produce both food and feed products is especially beneficial for entrepreneurs and producers interested in on-farm processing. He emphasized that extrusion technology will not replace solvent extraction but will add new niches for products that will aid farmers in the United States and other countries.

Following the speaker presentations at the Forum on Full-Fat Soybean Utilization, more than 50 people toured the BAR Export/Import research facilties. The highlight of the tour was a demonstration of the extrusion-expelling system developed by INTSOY.

Professor Robert Easter, swine nutritionist with the Animal Science Department at the University of Illinois, next presented an overview of research on full-fat soybeans and swine nutrition. He noted that swine nutrition systems are based on the availability of energy. Full-fat soybeans, in particular, can be used to increase energy density in the diet. This characteristic of full-fat soybeans means that more calories can be packed into a given quantity of feed. Research shows that fat in the diet is better used by the pig than an oral dose.

Easter emphasized that full-fat soybeans must compete with other energy sources. He suggested, however, that in addition to serving as a source of calories full-fat beans have other economic benefits. There is an apparent biological advantage in using full-fat meal for lactating sows and in nursery diets. Most experiments have shown an improvement in pig survival and reproductive performance among sows fed full-fat meal. Experiments have also shown that full-fat meal in the diets of finishing pigs gives them an advantage under heat-stressed conditions.

Professor Lowell Hill, international economist with the Department of Agricultural Economics at the University of Illinois, followed with an analysis of the potential for full-fat soybeans in Western Europe. According to Hill, full-fat soybeans is one of the bright spots for U.S. exports. During 1984-1985, there was an overall drop in U.S. soybean exports to Europe. Exports of full-fat soybeans, which were only a small part of total soybean exports, however, showed a good increase.

Hill said that the market for full fat depends on the relative price of protein and energy, the existence of a widely used rule-of-thumb limiting full-fat meal to 10 percent in rations, and the types of levies imposed on full-fat soybeans and other feed grains. The amount used in Europe is especially sensitive to the relative prices of competing feed grains. With current levies, soybean meal is almost equal in price to corn.

The potential is also highly dependent on the relative price of other energy sources. Hill predicted that downward price pressure will be the long-range trend for vegetable oils. This trend would favor the use of full-fat soybeans in feed because there would be less value in removing the oil.

Tom Kennel, a swine and soybean producer from Eureka, Illinois, wrapped up the morning session with an analysis of his on-farm extrusion operation. He processes his own soybeans for his swine herd and earns extra income by custom processing for several neighboring farms. According to Kennel, he earned enough profit to pay off his initial investment in only one year.

He uses or sells the meal as fast as he produces it. Neighbors report that the meal stores easily for five months or more. He used 6 percent fat in the sows' diets and recently raised the amount to 10 percent. Nursing diets consist of 18 percent protein and 8 1/2 percent fat.

Kennel reported several advantages in using the extruder: a reduced level of trypsin inhibitor, higher digestibility as the material expands following extrusion, better stability than meal to which oil has been added, better quality control with on-farm production, the ability to use a home-grown commodity, and improved dust control.

His records indicated a major improvement in whole-herd feed conversion by using full-fat soybean meal. In the period from 1982 to 1985, conversion averaged from 3.3 to 3.4 without the extruder. With the extruder, whole-herd feed conversion broke the 3.0 barrier in 1986 and 1987. He considers this one of the best indicators to determine profitibility in swine herds.

Focusing on extrusion-expelling. Following lunch, Lahkan Boodram, president of BAR Export/Import, presented an analysis of the future of full-fat soybeans on the Midwestern farm. BAR Export/Import is most involved in combining an extruder with a mechanical oil press to produce oil and a partially defatted meal. According to Boodram, this system has strong potential for use in developing countries as a low-cost means of producing both food and feed.

He pointed out that only degumming

is required to make a good-quality cooking oil. The partially defatted meal can be ground with a simple hammermill into a flour for breads and high-protein snacks. Soybeans can be combined with corn or rice in the extruder to make weaning foods and other food products. The oil can also be used as a dust suppressant or a feed additive.

Boodram noted that this versatility makes the extrusion/expelling system feasible for adding value to soybeans on farms in the United States. The main focus of Bar Export/Import, however, is to provide appropriate, small-scale technologies to developing countries. The company especially encourages a decentralized approach that brings processing closer to the farmer.

The program continued with a bus tour to the BAR Export research facilities for a demonstration of the extrusion/expelling system. Alvin I. Nelson of INTSOY and Herbert Heinicke of INSTA PRO conducted the demonstration for an overflow crowd. The bus then moved on to the final stop, which was a tour of the University's Swine Research Center.

INTSOY Economist Completes Study Of The Sri Lankan Soybean Industry

INTSOY agricultural economist Jane Gleason has recently finished a major, nine-month study of the Sri Lankan soybean industry. The purpose of the project was to evaluate the status of the country's marketing, utilization, and production of soybeans; to analyze the relationships among production and marketing, processing and utilization, and consumption; to assess the impact of the home and village training program at the Soyabean Foods Research Centre (SFRC); and to recommend strategies that would promote growth of the soybean industry.

The study was funded by grants from the Diversified Agricultural Research Project, the United States Agency for International Development, and the United Nations Development Programme. Additional support for the project was provided by INTSOY.

Evaluating the current status of soybeans. According to the final draft report, training and extension activities conducted through SFRC have been successful in making tens of thousands of Sri Lankans aware of the health benefits from eating soybean foods. This effort has created a significant consumer base, especially in rural areas, for increased soybean consumption.

Gleason points out, however, that the most important consideration for the average Sri Lankan consumer in purchasing food remains taste rather than nutritional quality. Interviews with extension personnel trained in soybean processing suggested that soyfoods have the best chance of being accepted by consumers if they taste good and are inexpensive and convenient to prepare.

As a result, for the average person in Sri Lanka, soybean products are most likely to be eaten in the form of traditional foods that are fortified with soy, rather than as whole soybeans cooked in the home. Indications are that, if sold at competitive prices and appropriately marketed, soy flour, fried tempeh, instant soy dhal, soy-fortified kola kenda, and soy snack foods could all become popular—especially if soy-fortification can be done without altering the traditional tastes.

Gleason notes that product development work at SFRC has been highly successful in making a wide variety of good-tasting, processed soyfoods. Sales of these products through commercial vendors, however, have been limited. Nevertheless, several major businesses and development organizations have recently expressed strong interest in marketing the products developed at SFRC.

Recommendations for future action. This combination of strong consumer acceptance and SFRC product development has produced a large potential for investment opportunities in making soy-based food products. Increased consumption of processed soyfoods in Sri Lanka, however, will probably depend on expanded involvement of the private-sector. To fully realize this economic potential, Gleason recommends that SFRC work closely with private businesses to promote the production and marketing of soy products developed at the center.

According to Gleason, this effort to promote investment in soyfood processing would be aided by increased cooperation between SFRC and the Industrial Development Board, local chambers of commerce, other business organizations, and interested donor agencies. She also suggests development of technical bulletins, equipment lists, and economic data that could serve as a resource base for investors interested in opening soybean processing facilities.

The final report on this study was recently submitted to the funding organizations. A revised version is scheduled to be published later in 1988 as part of the INTSOY publications series. It is hoped that this publication could serve as an important case study for those interested in starting or expanding soyfood industries in developing countries.

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INTERNATIONAL SOYBEAN PROGRAM

INTSOY

University of Illinois
at Urbana-Champaign
College of Agriculture

NEWSLETTER

INTSOY Research Aims to Expand Use of Soy Flour for Improved Human Nutrition

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A number of available commercial processes can directly convert soybeans into full-fat flour. This flour is high in protein, making it ideal as an additive for commercial bakery products or for supplementing the cereal grains used for manufacturing staple foods in many developing countries.

Nevertheless, full-fat soy flour has not been widely used, even in the poorest countries that have a desperate need for additional sources of low-cost protein and calories. One major problem is the high cost of milling full-fat flour. Because of the soybean's relatively high oil content, conventional milling equipment cannot produce a flour with particles small enough for easy blending with cereal flours.

The oil in full-fat flour also causes a number of storage, handling, and packaging problems. The high oil content greatly increases the rate at which the flour turns rancid. Furthermore, the flour has a brownish color that adversely affects the appearance of some food products.

But, according to recent research at INTSOY under the direction of utilization program leader Alvin I. Nelson, most of these problems can be overcome by using partially defatted meal produced by combining a single-screw dry extruder with a simple mechanical oil press. The meal or cake contains about 5 percent oil and almost 50 percent protein. The same process also produces a high-quality edible oil, which can be readily marketed as an additional value-added product.

Because of its lower oil content, this cake can be easily ground into flour with conventional milling equipment. The milled flour is a pleasing, light yellow and presents few handling and storage difficulties. The equipment for producing this flour is widely available and relatively inexpensive, allowing for flexibility in developing decentralized manufacturing operations.

Incorporating soy flour in baked products. The latest work conducted by INTSOY research associates Wilmot Wijeratne and Tsao Ming Wei, in collaboration with visiting researcher Marise Galerani, has focused on developing formulations and testing baked products containing partially defatted soy flour. Additional work on baked products was conducted by visting Indian scientist S. D. Kulkarni.

A major limiting factor in using soy flour in bread is reduced loaf volume. Soy flour absorbs and binds more water than regular cereal flours. Increased water absorption and retention keep soy-blended breads fresh for a longer time than wheat or cereal breads.

Initial research showed that all standard criteria of the baking industry for loaf size could be met by fortification with as much as 12 percent partially defatted soy flour. These properties could be improved even more by the addition of dough conditioners commonly used in commercial bread making. Test results were based on the use of standard baking equipment and procedures.

Visiting researcher Marise Galerani displays a wide variety of tasty, baked products made from partially defatted soy flour. This high-protein flour is ideal for commercial baking or for supplementing the cereal-based diets that are predominant in many developing countries.

By contrast, much of the bread in developing countries is made on a small scale, using completely manual techniques. The bread often varies in quality and loaf size. Work in the INTSOY laboratory has shown, however, that a loaf of respectable size with up to 12 percent low-fat soy flour can be made by manual bread-making techniques.

The longer freshness of soy-cereal breads is especially important in developing countries, where bread is most often not individually packaged or stored under controlled temperature. The protein content of the bread with 12 percent low-fat soy flour is increased by 25 percent over bread containing only wheat flour. The soy flour also improves the

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nutritional quality of the bread by complementing the amino acids in wheat and other cereal flours.

A number of other baked products with varying levels of added soy flour have been successfully tested in the INTSOY laboratory. These include: twist breads, 18 percent; biscuits, 12 percent; croissants, 10 percent; doughnuts. 10 percent; banana cake, 25 percent; carrot cake, 12 percent; plain cake, 25 percent; and muffins, 20 percent.

Tests have also been conducted on sugar cookies and other unleavened baked products, which are not affected by the problem of reduced loaf volume. The results have generally been acceptable with fortification up to 25 percent soy flour. At that level, cookies showed a 55 percent protein increase in comparison to those made with only wheat flour. Preliminary work on pie crusts with 25 percent fortification and pizza crusts with 12 percent fortification has shown promising results.

Adapting defatted soy flour technology to developing countries. The partially defatted soy flour is especially promising for adding protein to the diet in developing countries, where most of the staple foods are made from starchy cereals, roots, and tubers.

In India, for example, the staple unleavened bread known as chapati is made from wheat or other cereal flours. Experimental work by INTSOY, conducted in collaboration with visiting Indian scientist S. K. Mital, indicated that chapati could be fortified with as much as 20 percent soy flour and show only minimal changes in taste, color, and texture. The research further showed that low-fat soy flour could replace 30 percent of the milk solids or khoya used in the preparation of the popular Indian sweet product, gulab jamun.

In the African nation of Zambia, the major staple is mealy meal, which is made from waxy corn flour. This bland product is cooked in the form of porridge or nshima. It is eaten in combination with a tasty relish made from cooked beans or vegetables, or, less often, from meat and fish. Tests by INTSOY again showed clearly that 15 percent partially defatted soy flour could be added to the mealy meal without affecting the taste or color of the final cooked products.

In developing countries, the flour could be sold at retail as a finished product for use in the home or wholesaled to bakeries in the form of blended soy-cereal flour. Certainly, additional work is needed to investigate the use of this flour on a country-specific basis. Building a market for soy flour, however, will clearly depend on continued demonstration of its ability to supply high-quality protein at a reasonable cost and with minimal changes in the taste, texture, and color of local foods dishes.

University of Illinois researchers played a major role introducing soybeans into India during the mid-1960s. Today India is not only an important producing nation but also one of the world's largest markets for imported soybean oil.

INTSOY Hosts Visiting Scientists From India

INTSOY recently hosted six Indian scientists from the Central Institute of Agricultural Engineering and G. B. Pant University of Agriculture and Technology. Five of the researchers were sponsored by the United States Agency for International Development through Winrock International. The sixth scientist visited under the sponsorship of the United Nations Food and Agriculture Organization.

The researchers from G.B. Pant University in Pantnagar were Brij K. Mital, Yogesh C. Aggarwal, Surendra K. Mittal, and Ashok Tikkoo. B. K. Mital serves as professor and head of the Department of Food Science and Technology. His special interest is developing soy yogurt and fermented soyfoods. Aggarwal is professor in the Department of Post Harvest Process and Food Engineering. His main focus is the processing of oilseeds and cakes, with an emphasis on using alcohol as a solvent for the extraction of edible-grade meal.

S. K. Mittal, assistant professor in the Department of Food Science and Technology, centers his research on product development of soy-based foods, emphasizing preparation of soy concentrates by traditional methods and by fermentation. Tikkoo, associate professor in the Department of Post Harvest Process and Food Engineering, concentrates his work on postharvest technology and technology transfer.

The two researchers from the Central Institute of Agricultural Engineering in Bhophal are Birendra S. Bisht and Sitaram D. Kulkarni. Bisht, a senior scientist in process engineering, is mainly interested in developing pilot plants for the manufacture of soy-flour tofu, soy snacks, extracted soy products, and soy-blended baked goods. Kulkarni, also a senior scientist in process engineering, is currently developing technology and equipment for using soy flour in baked products.

During their three- to four-month stays, the scientists worked on INTSOY's extrusion/expelling and baking projects and on various projects in the Departments of Agricultural Engineering and Food Science. They also received specialized training at Kansas State University, Colorado State University, and Texas A&M University.

Additional activities during their stay included visits to several soybean processing and equipment businesses, the USDA Regional Laboratory in Peoria, and the annual meeting of the Institute of Food Technologists in New Orleans.

India Returning to Focus On Soybeans As Human Food

The idea of the soybean as a human food has finally come full circle in India, according to the six visiting researchers from G. B. Pant University in Pantnagar and the Central Institute For Agricultural Engineering in Bhopal.

These Indian scientists, who recently completed collaborative research at INTSOY, noted at a joint seminar presentation that the soybean was primarily viewed during the mid-1960s as a way to alleviate protein deficiencies in the average Indian diet. A major program on soybean production and utilization was started during that period in collaboration with the University of Illinois at two centers—Pantnagar in northern India and Jabalpur in central India.

The soybean initially was designated as a pulse crop, with emphasis on its use as a dal. The soybean was particularly attractive because it contains about 35 percent protein, compared to only 22 percent in traditional dals. In addition, the soybean has an amino acid pattern that more closely resembles those of meat and milk.

Focusing on soybeans as an oilseed crop. Nevertheless, this initial focus began to change as the edible oil shortage became more acute in India during ensuing years. Today India spends the equivalent of almost $1 billion per year to import edible oils. At the same time, oilseed production in India has been stagnating at about 13 million metric tons per year. Local production of edible oil is about 3.5 million metric tons per year. Annual imports amount to about 1.2 million to 1.4 million metric tons.

Per-capita fat availability in India currently is about 11 grams per day. This figure compares to a recommended daily level of 30 grams. The bulk of the edible oil comes from major oilseed crops, such as peanut, mustard, linseed, and coconut. A small amount comes from nonconventional sources, including rice bran and palm.

As a result of the ongoing edible oil crisis, solvent extraction has become the mainstay of the soybean industry. Today approximately 98 percent of the soybean crop, amounting to about one million metric tons yearly, is used for oil extraction. This yields about 160,000 to 180,000 metric tons of oil and 700,000 to 800,000 metric tons of soybean meal.

Virtually all the oil is sold locally as ebible oil, whereas almost all the meal is exported. The meal is generally exported at a price equivalent to about US$150 per ton. Recently, however, India has faced increasing problems in disposing of the meal because of competition from other countries.

Moving toward a new emphasis. This difficulty in exporting soybean meal has brought soybean utilization full circle to a renewed focus on using the almost 50 percent protein in soybeans as human food. As a result, new efforts currently are under way to develop processes for manufacturing a wide variety of soy-based foods that fit Indian dietary patterns.

Although there is an emphasis on using defatted soybean meal, work is also moving ahead on whole soybean utilization for such products as soymilk, dairy analogs, and soy paneer. Researchers at G. B. Pant University in Pantnagar, for instance, have already released a soymilk process for commercial exploitation.

M/S Pantnagar Soy Products in New Delhi is currently producing about 100,000 packets of soymilk per day. Each packet contains about 200 milliliters of soymilk. Several other industrial companies are looking into producing soymilk.

Other Indian companies are using defatted soybeans as a base for foods that appeal to Indian tastes. The Soybean Production Research Association in Bareilly several years ago introduced a variety of extruded products, including snack foods and vegetable curry substitutes. Although this oranization was eventually closed, its sucesses led to the establishment of a number of factories making extruded soy products.

Recently Brittania (India) has started marketing edible-grade defatted soy flour to be used as a supplement in chapati, puri, paratha, and other traditional foods. In this formulation, the recommended level of supplementation is about 10 to 15 percent soy flour. This work has also attracted the attention of Glindia and other large manufacturers. Many other companies use defatted soy flour to raise the protein level in bread made from wheat flour.

According to the Indian scientists, soybean utilization for food is now on a firm basis in India. They pointed out, however, that soybean meal will continue to be a cheaper source of protein than whole beans because much of the cost can be recovered from the oil. At the same time, they agreed that it will require increased effort from government agencies, private industries, universities, and research institutions for the average Indian to benefit from the soybean as an important component in the diet.

Meal From Extrusion/ Expelling Proves Effective In Swine Rations

Recent feeding trials conducted by Professor Bob Easter and graduate research assistant Mark Newcomb from the Animal Science Department at the University of Illinois confirm that partially defatted meal from the extru-

sion/expelling process can be used effectively in swine diets.

The study, which was partially funded by INTSOY, compared three types of swine diets: corn and solvent-extracted soybean meal, corn and soybean meal with added oil, and corn with soybean cake from extrusion/expelling. The trials used a random block design with 90 finishing pigs fed from an initial weight of 60 kilograms to a final weight of 100 kilograms. The corn and solvent extracted soybean meal diet served as a control. The diet with added oil was formulated to match the calorie content in the expeller cake diet. The results show that the cake from extrusion/expelling supports daily weight gain at a rate similar to the diet with added oil. The average daily gain measured in kilograms was .821 for the corn and solvent-extracted meal, .879 for the corn and soybean meal formulation with added oil, and .845 for the expeller cake.

The diet using the cake from extrusion/expelling, however, showed a slight decrease in feed intake in comparison to the added oil diet. The figures on average daily feed intake for each diet were: 2.726 kilograms for the basic corn-soybean diet, 2.702 kilograms for the corn and soybean meal with added oil, and 2.640 kilograms for the expeller cake.

The overall feed efficiencies clearly indicate that the diet containing cake from extrusion/expelling is basically equal to the control diet with added oil, and both are more efficient than the corn and solvent-extracted soybean meal diet. The feed efficiency figures are .302 for the solvent-extracted meal, .325 for the diet with added oil, and .321 for the expellercake.

In summary, this new study confirms that cake from extrusion/expelling can be used in pig diets if the formulations take into account the additional fat in such diets compared to the normal solvent-extracted meal.

Soybean Markets in Bangladesh Primed For Future Expansion

The market for soybeans in Bangladesh is now at a critical stage where implementation of small- and medium-scale processing technologies could have a major impact, according to Jane Gleason, INTSOY agricultural economist. Gleason recently spent 12 days in Bangladesh visiting soybean processing facilities and meeting with officials from the government, private volunteer organizations, and local businesses.

She reports that the Mennonite Central Committee (MCC) has been especially active in promoting increased soybean utilization. Working with local biscuit manufacturers, MCC has helped introduce the concept of fortifying wheat flour with full-fat soy flour. Two biscuit makers are already using soy flour, and at least three others are testing the product. Most of the biscuits are made from raw soybean flour. The trypsin inhibitor is largely destroyed by heat during baking.

Initially, MCC produced the flour at its processing laboratory in Maijdi. The flour was then sold to the manufacturers through MCC's wholesale outlet. More recently, the biscuit companies have been directly purchasing whole soybeans for processing in their own facilities. One of these companies already produces more than one metric ton of soy-fortified biscuits per day.

Other organizations, such as Biman and a Baptist Church group, are experimenting with soybeans as animal feed, especially for poultry. In addition, at least two entrepreneurs are interested in producing a soymilk that would be marketed in competition with soft drinks. The two companies are expected to require at least 550 metric tons of soybeans per year.

The biscuit manufacturers currently act as wholesalers by reselling excess beans to other users. For most soybean transactions, MCC acts as the go-between by identifying and directing potential users to the wholesalers. MCC further guarantees to purchase unsold soybeans, thereby absorbing the risk for the dealers.

The Source, which is MCC's local outlet, also sells processed soy flour at retail and about 400 to 500 kilograms of soybeans per month on the wholesale market. Most of these soybeans are purchased by the local Chinese community to manufacture tofu.

Promoting rural development with soybeans. Another important component of the soybean program in Bangladesh is the Food Products Development Centre (FFDC). The major objectives of FFDC are to develop low-cost food processing technologies that are assessible to the rural unemployed and to increase use of soybeans and other crops that can improve nutrition in the rural areas. As part of its effort to create new jobs, FPDC plans to promote small-scale commercial processing of soybeans for manufacture of the local snack food, chanachur.

During 1987, Ellen Jayawardena, training coordinator for the Soyabean Foods Research Centre in Sri Lanka, conducted several classes for FPDC personnel on home and village soybean preparation. These people, in turn, are to serve as local trainers. MCC also has several soybean cooking demonstrators in the Noakhali and Chuadanga districts and the Dhaka area. In addition, MCC personnel have sold soybeans door-to-door in a number of villages where that commodity is in short supply.

Gleason reports that both extrusion cooking and soymilk processing have significant potential for expanding soybean markets in Bangladesh. She further concludes that the extrusion/ expelling process developed by INTSOY could play an important role in providing a new source of high-quality soy oil for Bangladesh.

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INTSOY

NEWSLETTER

No. 41
April 1989

Remodeled Facility Bolsters INTSOY's Research and Development Efforts

Following more than a year of dislocations due to construction, INTSOY has moved into the newly remodeled Agricultural Bioprocess Laboratory (ABL) on the University of Illinois campus. The entire remodeled area encompasses more than 10,000 square feet of laboratory and office space in the basement and first floor of the former Dairy Manufactures Building. Nearly $1.4 million in remodeling costs were provided by the State of Illinois through the "Build Illinois" program and a special legislative appropriation for value-added research.

The new facility for the first time combines INTSOY's laboratories, kitchen, and pilot plant in one convenient location. The new location also provides easy access to the value-added activities in the nearby Burnside Laboratory and Agricultural Engineering Sciences Building. In addition, the ABL is located close to the proposed site for the National Soybean Research Laboratory.

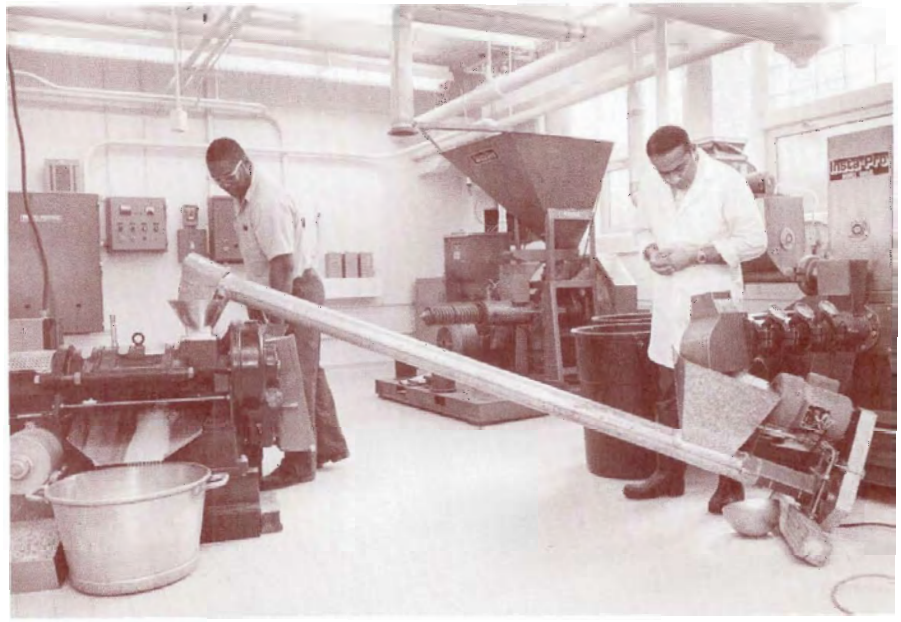
Besides INTSOY, the remodeled building will house researchers from the departments of Food Science and Agricultural Engineering. Much of their effort is focused on improved bioprocessing of corn and other commodities into industrial fuels and chemicals. The centralized arrangement represents a major commitment by the University of Illinois and the State of Illinois to expanded value-added research with both national and international applications.

Expanding the soybean research base. The INTSOY facility centers on a 2,600-square-foot pilot plant in the basement of the building. The main pilot plant is divided into dry and wet processing areas. The dry processing section will serve as the focal point for research on extrusion processing of soybeans and cereals and for development work using an extruder-expeller combination to extract oil. This area will house two extruders—INSTA-PRO 2000 and INSTA-PRO 600 Jr., several continuous oil expellers, and other related equipment.

The adjacent wet processing section is designed for work on soymilk, dairy analogs, and immature green soybeans. This area will have an array of steam-jacketed kettles and specialized equipment for soymilk extraction and green soybean processing.

A new tool and repair room will make pilot plant operations and maintenance more efficient. Reserve equipment items can be brought into the pilot plant as needed, allowing optimum use of the available space for a wide range of research projects.

A nearby 400-square-foot space will house equipment for milling dry ingredients and finished products. This area will serve as a central milling location for all the research and development projects. It will also be the eventual site of a new grain milling pilot system.



INTSOY researcher Wilmot Wijeratne (right) and Joe Williams of the maintenance staff conduct tests of the extrusion-expelling system in the newly remodeled Agricultural Bioprocess Laboratory. The 2,600-square-foot, pilot plant area will serve as a focal point for expanded research on extrusion processing of soybeans and cereals and on extruder-expeller combinations for oil extraction.

A test kitchen of nearly 700 square feet will serve as the primary area for developing new products, ranging from oriental-style green soybean dishes to soymilk and extruded snack foods. Additional space and equipment will allow for expanded work on new products using soy flour blends. This area will also provide much-needed space for a revitalized program of research on home and village food products made from soybean-cereal combinations.

An adjacent 500-square-foot laboratory will serve as the central facility for chemical and physical analysis. The laboratory will have equipment and instrumentation for chemical analysis, oil quality analysis, and a limited amount of microbiological evaluation. Currrent plans call for a significant upgrading of the analytical laboratory in the near future.

For the first time, these new facilities will provide INTSOY with the physical resources necessary to optimize its research efforts. This resource base, combined with improved access to facilities in the Food Science and Agricultural Engineering departments, should now allow INTSOY to greatly expand its research and development programs both in the United States and abroad.

Interest in Soybeans Continues to Grow Across Much of Africa

Recent developments in Africa point toward an increased demand by agricultural leaders for expanded soybean utilization efforts, according to Karl Weingartner, INTSOY senior food technologist. Weingartner recently completed a six-week trip to Uganda, Kenya, Zambia, Zimbabwe, the Ivory Coast, Ghana, Togo, Benin, and Nigeria. The purpose of the visit was to collect information on current soybean marketing, utilization, and research efforts.

The West African part of the trip also served as an exploratory step in developing a utilization project that would be co-sponsored by INTSOY and the United Nations Food and Agriculture Organization (FAO). A major component of the project involves field testing of the new extrusion-expelling process developed by INTSOY. In this process, inexpensive equipment is used to produce high-grade soybean oil and partially defatted meal.

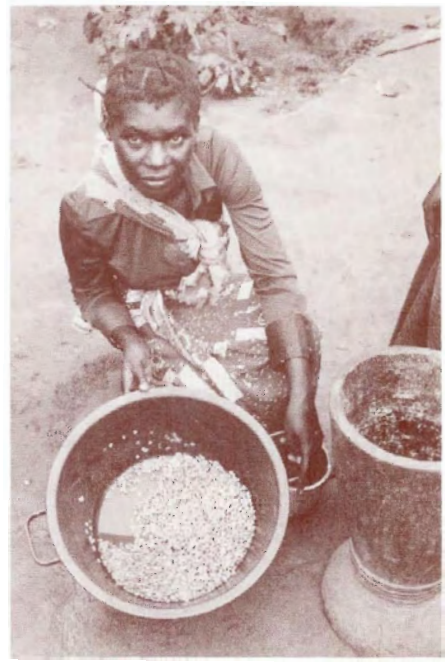
According to his report, officials in Uganda have a strong interest in expanding the use of soybeans. Help is needed, however, to train home economists and extension workers how to prepare soybeans in the home. The introduction of commercial processing equipment is needed for extracting oil from soybeans, and better ways must be found for using high-protein meal in both food and feed.

In Kenya, officials from the Ministry of Agriculture are reported to be working on a detailed plan for increased use of soybeans. Ken-Soya Company in Nairobi is attempting to obtain improved equipment for producing new food products, including full-fat soy flour, soy ugali, and soy snack foods. Plans were also discussed with USAID officials for a possible utilization workshop in 1990.

In Zambia, the Lee Yeast and Soy Nutrients companies continue to manufacture full-fat soy flour. Most of the flour is currently used by Zambian feed mills as a protein source for feed. Soy Nutrients is especially interested in expanding its product line to include more human food products.

A new program, the Zambia Agriculture Business and Marketing Service Project (ZAMS), is planning a major study on the feasibility of small-scale oil processing. Fred Javaheri, the national soybean coordinator, is working with a home utilization project in Luanshya that teaches poor urban women how to use traditional cooking equipment to prepare soyfoods.

In Zimbabwe, the Nutresco company is developing soy products for human consumption. Nutresco has recently solved some major technical problems and is moving ahead with plans to introduce new product lines by mid-1989. Lion's Den, another company, is especially interested in using the new extrusion-expelling technology to produce a partially defatted meal suitable for human consumption. In addition, food technologists from the International Crop Research Institute for Semi-Arid Tropics (ICRISAT) Program in Bulawayo have discussed the possibility of producing a high-protein, soybean-sorghum food.



A Zambian women displays soybeans that will be ground into flour for use in the local staple known as nshima. As the result of several utilization training programs, soybeans are becoming increasingly popular as a protein source in urban and rural areas of Zambia.

Focusing on West Africa. A major soybean project is scheduled to begin in the Ivory Coast during 1989. The office of the president and the Direction et Controlle des Grands Travaux are providing important support. Researchers are enthusiastic about developing commercial food products by extrusion cooking of soybeans. They are planning to locally market inexpensive, protein-rich foods in both urban and rural areas.

Soybeans have also generated a strong interest in Ghana, where there is a great need for an inexpensive source of edible protein in the central zone and the northern savanna. One focal point for this interest is the Food Research Institute in Accra, which has a well-trained and enthusiastic staff. The

Secretary of Agriculture and other government officials have also expressed support for increased soybean use.

In Togo, the Food Research Center is using roasted soybeans mixed with cereals to prepare baby food. Outside the center, distribution of the baby food is limited. Staff members are interested in setting up a small-scale process for producing soymilk in sterilized containers. The well-trained and knowledgeable staff at the center has been involved with soyfood production for about four years.

In Benin, work on soybeans is conducted by the Catholic Relief Service (CRS). In 1983, CRS began demonstrations of a soyflour preparation used to enrich the local potage and installed mills in 20 villages. A soy-maize baby food is available in a local supermarket. Soybeans are also used to make stock cubes, which are added to stews.

Nigeria remains especially active in expanding the use of soybeans. The country's growing commercial poultry industry has partly been held back by a lack of affordable feed. In several areas, such as northern Oyo State, soybeans are appreciated as human food and are affordable for families without the means to purchase meat or milk. In Oyo and Kaduna States, soybeans sold in local markets cost the same as cowpeas.

Oil mills in Zaria, Funtua, and Gusau are beginning to crush soybeans for oil and meal. Feed mills in Jos and in Oyo State roast whole soybeans for animal feed. A Nestle product and several other commercial baby foods made with soybeans are manufactured and widely distributed in Nigeria.

Well established food technology departments at several universities have used soybeans to develop acceptable dishes prepared in the home. In addition, health workers and home economists at the Baptist Mission at Ogbomosho have developed at least 20 locally acceptable foods that use soybeans as an ingredient.

Supported by a grant from the International Development Research Centre (Canada), the International Institute of Tropical Agriculture and the Institute for Agricultural Research and Training have conducted more than 50 soybean demonstrations in northern Oyo State. The two institutes also manufacture and sell soymilk on a daily basis. The initial success of these projects indicate that soybeans can become a significant food in Nigeria.

Agricultural leaders in Ghana, Nigeria, and the Ivory Coast have already expressed interest in the proposed INTSOY-FAO soybean utilization project. Overall, the demand for information on using soybeans for human consumption appears to have increased. Inexpensive, protein-rich foods should easily find markets in rural and urban areas. Most importantly, a successful soybean project would almost certainly attract private investment and enthusiastic research support.

Ethiopian Spreads Word On Soybeans As Way to Improve Local Diets

In some parts of Ethiopia, soybeans are known as "Gadissas" in tribute to the man who single-handedly travels the country teaching people how to use soybeans as a protein-rich food source. Others have simply dubbed Gadissa Gobena as "Mr. Soyabean." Westerners would most easily recognize him as the African equivalent of the American folk hero, "Johnny Appleseed."

Gobena, who recently visited INTSOY for a two-week utilization training course, first read about the "miracle crop" known as soybeans some nine years ago. In an action almost unprececented in a country where women traditionally do all the household work, he taught himself how to cook. From that simple beginning, he has developed a huge array of recipes and cooking techniques for turning soybeans into palatable local dishes.

He supports an extended family of 13 with four dairy cows and a small salary the government pays him to teach agriculture and nutrition at a secondary school in the Weyna Dega area just west of Addis Ababa. But, for much of the year, he is away from home on his single-minded crusade to improve the diets of his country's people by promoting the use of soybeans in food.

Carrying a few bags of soybeans provided by the government-sponsored Faffa Foods Factory, he travels along the dusty roads of the rural countryside conducting classes for housewives in villages along the way. Indeed, it is not uncommon for him to walk for several days across 100 kilometers or more to conduct a single training session. With only minimal financial assistance from the government or private aid organizations, he provides frequent training for teachers and area leaders who can pass along this information to others in the area.

Gobena has developed 58 different recipes fitted to local tastes in each part of the country. Classes are most often conducted in the field or under a tree near a village. He samples the women's efforts at preparing various soyfoods and offers his advise and, most importantly, his encouragement.

His trip to INTSOY traces back to events some 22 years ago, when he noticed an address inscribed inside a missionary Bible. He started writing to the woman who sent the Bible, Ruth Settles of Canton, Illinois. Over the years, he was unable to accept her frequent invitations to visit the United States. Finally, spurred by his interest in soybeans, Gobena boarded a plane bound for Illinois.

During his two-week stay at INTSOY, he worked on improving the taste and quality of his home recipes. Much of the training focused on eliminating any traces of a beany flavor and on insuring proper destruction of the antinutritional factors in soybeans. He also spent time studying the extrusion-expelling technique that processes soybeans much more quickly and on a larger scale than the hand methods he normally uses.

INTSOY to Co-Sponsor Major Soybean Utilization Conference in China

Details have been finalized for a major soybean utilization conference and equipment exhibition to be held in Gongzhuling and Beijing, China, from August 7 to 15, 1989. The conference will focus on small- and intermediate-scale processing technologies that can increase the use of soybeans in developing countries.

The sessions will bring together scientists, development workers, and businessmen from developing and selected developed countries. A primary goal is to encourage exchange of information on ways to blend traditional and modern technologies in the effort to expand the use of soybean protein to meet world nutritional needs.

The presentations will emphasize processing soybeans directly into palatable foods. Additional sessions will focus on increasing soybean use in livestock feed. Participants from more than 40 developing countries are expected to attend.

The participants will review the current status of technologies for processing and using soybeans and make recommendations on ways to expand cooperative research and development. A number of organizations and private businesses also will display a wide range of equipment and soyfood products.

The conference setting in China's Jilin Province is nearly ideal for learning how the Chinese have successfully used decentralized, small-scale processing to integrate soybeans into their food system. The sessions in Gongzhuling and Beijing will also provide an effective forum for scientists, equipment manufacturers, food processors, and development workers to exchange information relevant to developing countries.

Besides INTSOY, other sponsors of the conference are the Jilin Academy of Agricultural Sciences; the Chinese Academy of Agricultural Sciences; the Japanese Agriculture, Forestry and Fisheries Research Council Secretariat; the Scientific Research Institute of Foods and Fermentation Industry; and the International Institute of Tropical Agriculture.

The conference registration fee is US$75. The charge will increase to US$100 for late registration after July 1, 1989. In-country expenses, including hotels, food, and local transportation, are estimated at US$700. For additional information, contact:
Dr. Harold Kauffman, INTSOY,
113 Mumford Hall, 1301 W. Gregory Drive, Urbana, Illinois 61801, USA.

World Bibliography of Soybean Entomology Available from University of Illinois

Research in soybean entomology has grown enormously in the last 20 years as a consequence of the expansion of the crop throughout the world. Publication of the *World Bibliography of Soybean Entomology* by the Soybean Insect Research Information Center of the Illinois Natural History Survey and the University of Illinois represents the culmination of seven years of painstaking research.

More than 5,000 documents have been collected, classified using a thesaurus of hierarchial key words, and processed for electronic storage and retrieval. Funded by the Illinois Agricultural Experiment Station, this 1,000-page bibliography in two volumes is indispensable to those interested in soybean production and protection.

Volume I contains a list of major pest species in each of six production regions of the world and a bibliometric study of the literature. Bibliographic entries appear in alphabetical order by author. Each entry is followed by a string of key words that reflect the subject contents.

Volume II contains six indexes that refer to the sequentially numbered entries. These include: author index, geographic index, host plant index, taxonomic index, general descriptor index, and language index. Volume II also includes lists of abbreviations for all periodical titles in the bibliography.

The cost for the two-volume set is $65. International orders must be prepaid by checks cleared through a U.S. clearing bank. For faster delivery of international orders, add airmail postage to the cost of each set: $6 for Canada and Mexico; $10 for the Carribean and Central America; $16 for South America, Europe, and North Africa; and $23 elsewhere. Checks should be made payable to the University of Illinois. For orders or additional information, please contact:
University of Illinois, Office of Agricultural Communications and Education, 54 Mumford Hall, 1301 West Gregory Drive, Urbana, Illinois 61801, USA.

New Film For Children Features INTSOY Research

INTSOY scientists, along with several researchers from other programs at the University of Illinois, are featured in a new film entitled "S is for Soybean." The 13-minute feature is aimed toward school children in grades one through six. The film is part of a series on "Food From A to Z."

The purpose of the program is to inform students about the health and nutritional importance of soybeans as human food. It also relates some of the history and the tales and legends about this incredibly versatile crop. The program is available for sale and rental in both film and video formats. Requests for information on prices and available formats should be directed to:
Handel Film Corporation, 8730 Sunset Boulevard, Los Angeles, California 90069, USA.

The INTSOY Newsletter is published quarterly by the International Soybean Program at the University of Illinois at Urbana-Champaign. INTSOY Director: Harold E. Kauffman. Editor: Robert Wynstra. INTSOY is an affirmative action/equal opportunity employer.

INTERNATIONAL SOYBEAN PROGRAM

University of Illinois
at Urbana-Champaign
College of Agriculture

INTSOY

NEWSLETTER

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Popularity of Soyfoods Receives Major Boost in Sri Lanka

Efforts by Plenty Canada to popularize processed soybean foods for improved nutrition and as a new income source are showing widespread success in Sri Lanka. Plenty Canada is a nongovernmental organization that has a contract with the Canadian International Development Agency (CIDA) to fund this project. The current effort is part of a five-year program in soybean utilization carried out in collaboration with the Sri Lankan Ministry of Agricultural Development and Research and the Ministry of Plan Implementation.

Four full-time Canadian professionals in small-business education, agricultural development and administration, and nutrition are currently working on the project. CIDA has recently agreed to fund the project with $Canadian 4.7 million for five years.

The goals are to promote soy foods, to assist in setting up processing facilities, and to transfer processing technologies to the private sector. This thrust is aimed at increasing the amount of soybean consumption by urban and rural low-income groups who are most vulnerable to malnutrition.

Promoting new products. Plenty Canada has worked closely with the Soyabean Foods Research Centre (SFRC) in Peradeniya to promote a number of products and processing techniques developed by INTSOY. Of particular interest is the process that combines a dry extruder with a mechanical oil press to produce edible oil and low-fat soy flour.

Plenty Canada has now completed Phase I of the project, which links more than 150 producers and retail outlets into an integrated marketing network. Two processing and retail centers are operating—one in Kandy and the other in Colombo. Retail outlets operating in Kandy, Colombo, and 9 other districts currently sell more than 35 processed soybean products. Sales for 1991 are projected at more than $Canadian 100,000.

As part of this promotional effort, Plenty Canada is providing loans and technical assistance for small-scale soyfood processing projects. The group also provides short training courses for would-be entrepreneurs in the soyfood business. The project has already generated a number of new jobs for the formerly unemployed.

Another effort is aimed at educating local community groups in nutrition and the importance of soybeans as a high-quality source of protein. With the help of local experts, Plenty Canada has published several recipes on how to prepare the soybean products sold through the distribution network. Products that are available include: soy ice cream, soy yogurt, tempeh, soy meat, soy instant dhal, soy-cereal mix, soy cocktail mix, and soy flour.

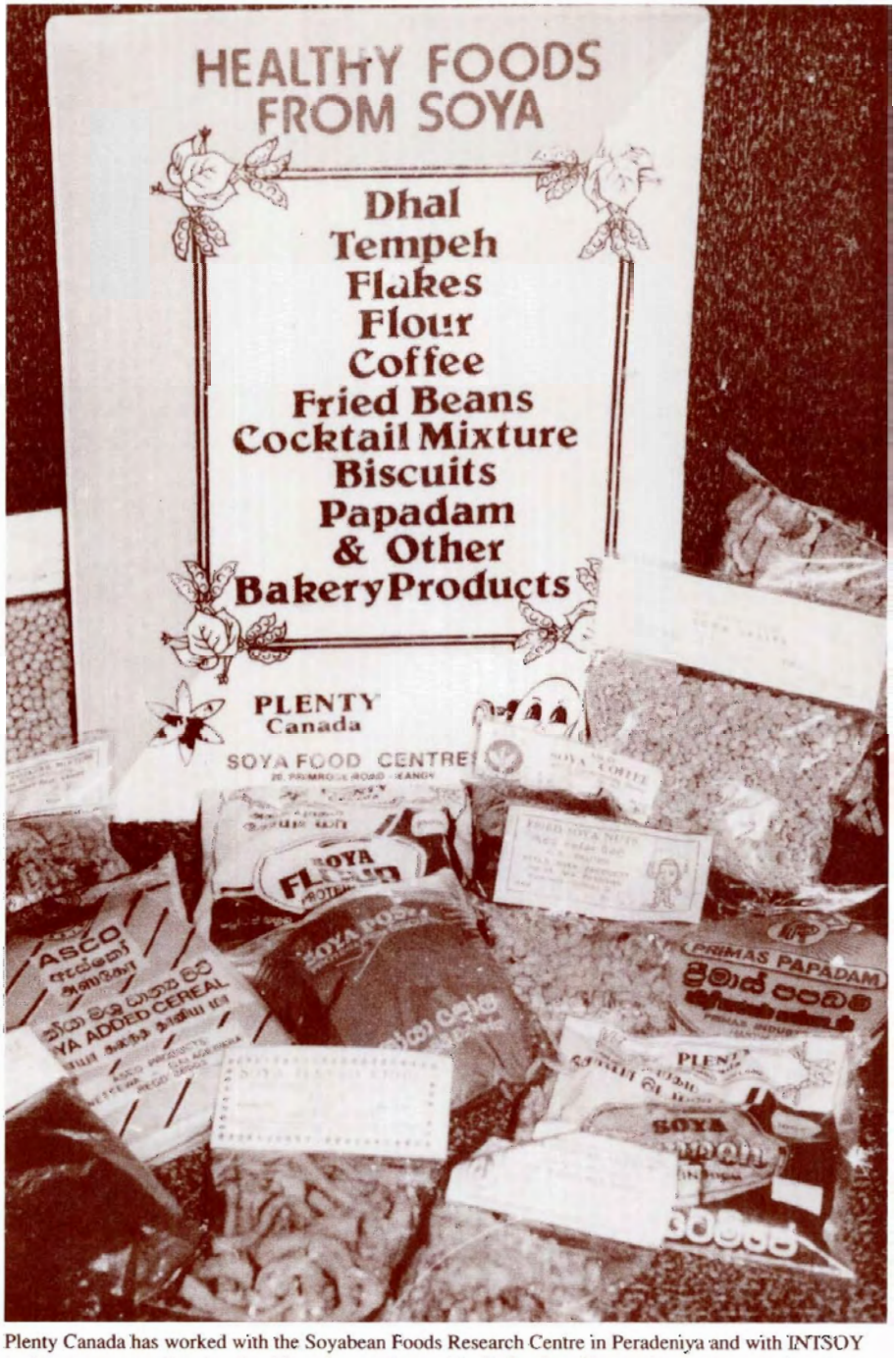
Much of the project's success comes from supplying soybean products, such as dehulled soy, soy flour, and soy dhal, which are then processed by small-scale entrepreneurs into finished products for market. Because of the increased demand for these products, Plenty Canada is considering setting up

People line up in Colombo, Sri Lanka, to buy soy ice cream from a mobile kitchen operated by the Soya Utilization Project. The project is jointly sponsored by Plenty Canada, the Sri Lankan Ministry of Agricultural Development and Research, and the Ministry of Plan Implementation.

its own processing facility by the end of the year.

The SFRC's home training program will soon be integrated with the programs for extension, education, and training in the Department of Agriculture. Plenty Canada is currently negotiating the possibility of collaborating with the new organization to carry out soybean foods promotions and training activities.

Plans call for INTSOY to continue assisting SFRC in developing improved processing techniques and new food products. INTSOY technical staff will also work closely with Plenty Canada and SFRC to help develop an extrusion/expelling plant in the private sector. This will not only supply products for extension work but will also serve as a model for attracting new entrepreneurs to the soybean processing business.



Plenty Canada has worked with the Soyabean Foods Research Centre in Peradeniya and with INTSOY to develop prepared soyfoods with widespread appeal in Sri Lanka. The products are currently available in Kandy, Colombo, and several other districts around the country.

Nelson Receives Major Award For Utilization Research

Alvin I. Nelson, professor emeritus in the Department of Food Science and senior research adviser for INTSOY, has been selected to receive the 1991 Meritorious Service Award for Utilization Research from the American Soybean Association. The award will be presented on July 29 at the Soybean EXPO 91 convention in Nashville, Tennessee.

The award cited Nelson for his dedication in developing new food and feed uses for soybeans. The citation notes that, during the last two decades, no single individual has made a bigger impact on developing innovative soybean processing methods, on training scientists and entrepreneurs worldwide in the application of these methods, and on setting the foundation for major gains in food uses for soybeans in the coming decades.

In the late 1960s, Nelson began research on the processing of whole soybeans into food. He developed basic concepts and initiated practical processing methods that have set the industry standard. During the 1970s, he applied these processing methods in India and Sri Lanka, where he helped establish innovative new pilot processing facilities.

In 1983, he was called out of retirement to develop a new soybean processing and utilization program for INTSOY and the Department of Food Science at the University of Illinois. His research team developed numerous innovative soy products from low-cost extrusion cooking.

More recently, Nelson and his team developed the processing method that combines the extruder with a mechanical expeller to produce partially defatted meal and natural oil. This technique is expected to be widely adopted around the world in the next few years. Nelson also has pioneered research on soy milk with improved flavor characteristics and on methods to commercialize frozen vegetable soybeans.

Wilmot Wijeratne, associate director of INTSOY, demonstrates the extrusion/expelling system to U.S. Representative Richard Durbin and his aide, Michael Daly. Looking on is Bill Savage, INTSOY research associate. The stop at INTSOY was part of a tour of federally funded facilities at the University of Illinois.

U.S. Congressman Tours INTSOY Facilities

A tour of the College of Agriculture facilities provided U.S. Representative Richard Durbin with first-hand evidence of the effective use of federal dollars at the University of Illinois. A special feature of the tour was a visit to the INTSOY pilot plant and test kitchen, where he tasted a variety of soyfoods and observed INTSOY's new extrusion and expelling system in operation. Much of this research was funded with federal money through the U.S. Agency for International Development.

Durbin, who is a Democrat, represents the 20th Congressional District in central Illinois. He is a member of the House Appropriations Committee and has played a key role in supporting many University of Illinois projects.

Durbin has visited many developing countries, including India, Bangladesh, Nepal, and Thailand, to observe the effectiveness of the U.S. Food for Peace Program. He is also a leading advocate for democratic change in Lithuania and the other Baltic states. He was accompanied on the INTSOY tour by W.R. "Reg" Gomes, dean of the College of Agriculture, and Donald Holt, director of the Illinois Agricultural Experiment Station.

Federal dollars at work. During his visit, Durbin sampled a wide range of soyfoods developed by INTSOY researchers. The menu included soy ice cream, soy yogurt, bread, cookies, and vegetable soybeans. Durbin also observed a test run of the extrusion/expelling system in the main pilot plant. The pilot plant tour was hosted by INTSOY associate director Wilmot Wijeratne and senior adviser Alvin I. Nelson.

"It was good to see our federal dollars at work," Durbin said. "The International Soybean Program is very promising and deserves continued support." Durbin was especially impressed by the extrusion/expelling system because it is small enough to be adapted for use in developing countries. The resulting products have the potential of increasing the quality of local diets and the demand for U.S. soybeans, he said. During his stay, Durbin also visited the federally funded Plant and Animal Biotechnology Laboratory and the site of the new National Soybean Research Laboratory.

INTSOY Collaborates in Testing Health Effects of Soy Foods

INTSOY researchers Karl Weingartner, Bill Savage, and Marise Galerani are collaborating with Susan Potter, assistant professor of foods and nutrition at the University of Illinois, on a human study of the health effects of soybean fiber and protein. The study will also analyze the acceptability of added soybean fiber and protein in popular American foods. Funding for the project is being provided by the American Soybean Association, the Illinois Soybean Operating Board through the Soybean Checkoff Program, and INTSOY.

In the current study, various soyfoods are providing 50 percent of the total protein intake for 20 men at the Veterans Administration Medical Center in Danville, Illinois. The high-protein, high-fiber foods in the study are based on a number of products that have been developed and refined at the INTSOY research facility. The products include blueberry and raisin-spice muffins, lemon pound cake, dinner rolls, cookies, fruit bars, and French bread.

The first test group was fed the specially prepared diets from August through December 1990. A second test group began receiving the soyfood diet in January 1991. The men, whose

average age is in the mid-fifties, are monitored closely to determine the physical effects of the diet. Of special interest is the effect of soy protein and fiber on cholesterol levels. The results of the study are expected to be available in late 1991.

Commercial Feed Operation Uses INTSOY Technology

The first commercial feed operation using the extrusion/expelling system developed by INTSOY is now open in Brodhead, Wisconsin. With the extrusion/expelling system, Super Soy Feeds processes slightly more than 2,000 pounds of soybeans per hour into low-fat dairy feed that can easily be customized for oil and protein content according to individual customer needs. The company also produces a large quantity of full-fat soybean meal using the extruder alone.

The oil from the expelling operation is sold to nearby farms as a dust suppressant or as a source of calories that can be added to various dairy rations. Super Soy Feeds currently has more than 300 customers and has been growing rapidly since it started extrusion/expelling operations a year ago.

The company traces its origins to 1983 when Trygve Strommen turned over management of his farm to his two sons and opened his own small feed business. The operation grew so rapidly that he soon brought his son Kurtis Strommen to help manage the business.

Initially, he operated with a single INSTA PRO 2000 extruder to produce full-fat meal for dairy feed. In 1988, he expanded by adding two more extruders.

Introducing extrusion/expelling. As early as 1987, Strommen was searching for ways to produce low-fat meal and usable oil. In 1989, he read a newspaper account of INTSOY's research which coupled an extruder with a mechanical oil expeller in a continuous process to produce partially defatted meal and high-quality natural oil. Soon afterward, he visited the INTSOY pilot plant for a demonstration and consultations with INTSOY researchers.

Strommen immediately began searching for an expeller to buy and finally located an Anderson model that had been rebuilt. With this in place, he started commercial extrusion/expelling operations in the summer of 1990.

Start-up costs for the company were relatively low because Trygve Strommen is adept at basic industrial design and engineering. He did all of the installation work himself and even started the extruders without assistance from INSTA PRO. Since then he has continued to modify the layout and operation of the plant to make it more efficient.

Currently Super Soy Feeds produces both low-fat and full-fat meal for dairy rations. This ability to produce both types of feed allows him to easily meet the needs of his customers. Local farmers benefit from having the processing done locally at greatly reduced costs for transportation and handling. Strommen says that the processing is also friendly to the environment. Most importantly, according to Strommen, the custom feeds produced from extrusion/expelling also increase milk production.

INTSOY Plans Expanded Cooperation With Utilization Project in India

The time is now right for INTSOY to assist in expanding the use of high-protein soyfoods in India, according to Harold E. Kauffman, INTSOY director. Kauffman, who recently returned from a two-week trip to India, recommends an aggressive collaborative effort between INTSOY and the Soybean Processing and Utilization Project (SPU) in India to involve the private sector in turning the potential of soyfoods into commercial reality.

The SPU project is funded by the U.S. Agency for International Development. It is being carried out in cooperation with the Central Institute of Agricultural Engineering in Bhopal and G.B. Pant University of Agriculture and Technology in Pantnagar. The goal of the SPU Project has been to establish a well-equipped research laboratory and pilot plant, to train a core group of scientists in soybean processing and utilization, and to develop simple processing technologies and equipment.

According to Kauffman, the project has already achieved considerable success in meeting these overall goals. He points out that a number of areas have significant potential for further research and development and for technology transfer to the private sector.

Promoting new products and processes. The most promising avenues for expansion include producing low-fat soy flour and edible oil from extrusion and expelling; producing full-fat soy flour, soy-cereal blends, and soy-pulse blends from extrusion cooking alone; producing food products with edible-grade defatted flour from existing solvent extraction plants; increasing the use of all types of soy flour in bakery products; and producing soy paneer and soy-based dairy analogs.

Several joint INTSOY-SPU activities are currently in the planning stage. The major focus of these efforts is on scientific and business exchanges and on collaborative research. Another area of interest is a special training and promotion program that would include joint sponsorship of an international seminar on soybean processing and utilization to be held in Bhopal this November.

The INTSOY Newsletter is published twice a year by the International Soybean Program at the University of Illinois at Urbana-Champaign. INTSOY Director: Harold E. Kauffman. Editor: Robert Wynstra.

INTERNATIONAL SOYBEAN PROGRAM

INTSOY

No. 45, June 1994

NEWSLETTER

New Collaborative Program Promotes Agribusiness in Developing Countries

As part of a major structural change, INTSOY recently joined the new Postharvest Collaborative Agribusiness Support Program (CASP) sponsored by the United States Agency for International Development (USAID). This move brings INTSOY and three other programs supported by USAID together in a dynamic program aimed at increasing agribusiness and promoting sustainable agriculture in developing countries.

The other CASP members are the Food and Feed Grains Institute at Kansas State University, the Postharvest Institute for Perishables at the University of Idaho, and the Seed Technology Laboratory at Mississippi State University. Overall management for the CASP is located at Mississippi State University. The cost for this five-year collaborative effort is estimated at US$7.5 million.

The new Agribusiness CASP is designed to reduce postharvest losses and problems in food and feed grains, fruits and vegetables, seeds, and soybeans and other food legumes. For INTSOY, a key change is expansion of its mandate to include postharvest aspects of food legumes other than soybeans.

Overall goals of the CASP

The overall project encompasses a broad program of field support, applied research, training, and transfer of technical information. These activities are directly targeted toward small and medium agribusinesses, individual entrepreneurs, and rural households and communities. Inclusion of a component for women in development ensures that women will have equal access to all the CASP programs.

The agribusiness CASP is designed to provide USAID field missions with broad postharvest expertise from the U.S. public and private sectors. Each project member will work to support local USAID missions in stimulating interest in postharvest technologies. CASP members also will respond directly to the specific needs of countries requesting assistance.

A major part of the CASP effort is directed toward a program of applied research aimed at adapting proven processes and technologies to overseas conditions. The applied research component is specifically designed to address problems faced by medium-scale agribusinesses. Emphasis is placed on problems and regions where the research can have the greatest and most immediate impact.

Another important CASP activity centers on training for managers and technical personnel from existing and new agribusinesses. The training program focuses on policy analysis, business and personnel management, and improvement of skills associated with specific commodities and industries Individual training sessions will be augmented by a series of regional traveling workshops.

Each CASP member will continue to serve the information needs of its commodity-specific clientele. In addition, the overall CASP management will coordinate information activities that serve a worldwide clientele. Activities will range from newsletters and information packets to worldwide directories and electronic bulletin boards. The focus is directed toward dissemination of "cutting-edge" technological information developed by individual CASP members.

INTSOY's selection as part of the new Postharvest CASP has provided a major boost in applied research using a twin-screw extruder for texturization of full-fat and low-fat soy flour as a meat extender.

169 Environmental and Agricultural Sciences Bldg., 1101 W. Peabody Drive, Urbana, IL 61801, USA; (217) 333-6422

The expanded INTSOY mandate

For INTSOY, the agribusiness CASP provides a boost in applied research activities. One project will finish work on scaling up the extrusion-aided screw press technology for transfer to small and medium-sized agribusinesses. Work is also underway on developing new techniques for texturization of full-fat and low-fat soy flour for use as a meat extender. This process will allow agribusinesses to produce meat extenders from locally grown soybeans and will help overcome the high cost of importing defatted soy flour and other processed soy products.

INTSOY also is moving ahead on efforts to develop commercial products from co-extrusion of soybeans with traditional food legumes. This will create a new technology base for agribusinesses and will add value to traditional food legumes. In addition, INTSOY researchers are developing new methods for incorporating processed soy flour into traditional cereal and legume foods. The goal is to increase the supply of new convenience products in the food chain.

Another major area of interest for INTSOY is support for development of agribusiness ventures involved in the processing of soybeans and traditional food legumes. Support will be provided through USAID field missions and various partner institutions.

Several projects already are under consideration in South Africa, Ethiopia, Kenya, Zambia, Nigeria, and El Salvador. Planning also is underway in Brazil on a long-term project for the transfer of soybean food processing technologies and the application of soybeans for food uses in rural communities.

In the Philippines, the United Nations Food and Agriculture Organization (FAO) has requested support for a major soybean development project. INTSOY will focus on postharvest processing and utilization and will work with the Philippine Council of Agricultural Research to develop an agribusiness component for the project.

INTSOY Assists Egypt in Establishing Model Soy Foods Processing Pilot Plant

As a first step toward the final goal of establishing a soy foods center, INTSOY and the Food Technology Research Institute (FTRI) at the Agricultural Research Center (ARC) have opened a model processing pilot plant and food demonstration facility in Egypt. This pilot plant provides an invaluable resource for research and development of soy foods adapted to the Egyptian diet and serves as a training center for introducing new soybean processing technologies to the Egyptian private sector.

FTRI was established in 1991 by the ARC as a specialized institute for research on food processing. The institute has a staff of about 150 researchers and operates several food processing pilot plants. Its facilities are located at the ARC complex in Giza, which provides a nearly perfect setting for the new pilot plant and food demonstration center. Support for the project was provided by the New Initiatives Office of the National Agricultural Research Program and the United States Agency for International Development.

The pilot plant facility

The pilot plant building, which was formerly used for processing of fruit juice, has been extensively remodeled. The refurbished facility contains more than 230 square meters of usable space for the pilot plant and adjacent product display area. The site also houses classrooms and a quality control laboratory.

The seed preparation room contains equipment for cleaning and dehulling raw soybeans. This area is directly connected to the dry processing room, which houses the extruder and other equipment for the continuous processing of soybeans into oil and flour. The area is fully outfitted with ancillary equipment needed to grind soy meal into nutritious flour ready for baking.

The adjacent wet processing area contains complete systems for the production of soy milk, tofu, and dairy analogues, such as soy ice cream and soy yogurt. Another room is fully equipped as a test kitchen and display area for new food products.

Together these new facilities provide the key component in developing a comprehensive soy foods development center. The new pilot plant functions as a focal point for accelerating the development of new soy products for Egypt. Most importantly, it serves as a model for stimulating local entrepreneurs to use soybeans in commercial food products.

INTSOY Director Wilmot Wijeratne (right) trains Egyptian scientists to operate the extrusion-aided screw press system at the new FTRI processing pilot plant. The facility will serve as an important model for expanding the production of nutritious soy foods in Egypt.

Project Helps Restructure Postharvest Systems in Ukraine

More than a year of important new activities have culminated in the recent announcement that INTSOY will serve as a major sub-contractor with Freedom Farm International of St. Joseph, Illinois in a project in Kherson Oblast, Ukraine. The Black Sea Model for Privatized Postharvest Grain Systems is a key component in the initiative developed by the United States Agency for International Development (USAID) for restructuring food systems in the newly independent states of the former Soviet Union.

"The idea is to establish a model for integrated farming in privatized institutions under the principles of free enterprise," says Wilmot Wijeratne, INTSOY director. "The overall objective of the project is to establish a sustainable and replicable model for postharvest grain systems using state-of-the-art technology and expertise from the United States."

USAID is funding the project through the Citizens Network for Foreign Affairs in Washington, D.C. based on a joint proposal by Freedom Farm International and INTSOY. USAID contributed US$1.745 million for the project.

The Freedom Farm program

Freedom Farm International has been working in the Ukraine since 1992. Its philosophy centers on a commitment to improving the quality of life in the newly independent states of the former Soviet Union. This is accomplished by assisting local partners to help themselves through development of new business and personal relationships. Joseph Parker and Roger Denhart, the president and vice president of Freedom Farm, are successful farmers with professional training and experience in production and marketing of grains and oilseeds.

Freedom Farm will work on this project with recently privatized Ukrainian farms to establish an integrated system that includes on-farm feed and food processing and feed utilization for improved livestock productivity. Ukrainian partners will receive training in up-to-date agricultural practices, on-farm grain storage and handling, value-added processing technologies, and the basics of the free enterprise system.

The Kherson Oblast region

Kherson Oblast is located in the southern Ukraine in the steppe region of the Black Sea lowlands near the Dnieper River. The climate is temperate and well suited for growing a number of commercial crops. In 1983, the area had 147 collective farms and 145 state farms cultivating a total of 1,744,000 hectares.

The main crops are winter wheat, sunflower, corn, barley, legumes, rice, millet, castor beans, alfalfa, and assorted vegetable. Animal production centers on dairy and beef cattle, swine, sheep, and poultry.

The critical agricultural problems in the Ukraine are postharvest losses and inefficient marketing systems. Currently there is sufficient grain available for animal feed. What is lacking is an adequate source of protein for use in animal feed. As a result, a number of local producers have expressed interest in developing soybean production and medium-scale processing as a way to meet this critical protein shortage in animal feed rations.

Four privatized farms located within an 80-kilometer radius have committed to participating in the project. Each farm has set aside approximately 1,000 hectares of irrigated farm land for the project. One of the farms is located adjacent to the Dnieper River. This strategic location will serve as the site for the central grain handling, processing, and shipment facilities.

Each of the four farms will install grain storage bins with a capacity of 4,500 metric tons. This will allow individual farms to hold grain stocks for trade when market conditions are optimum. The central storage facility will handle another 4,500 metric tons of grain for transfer to barges on the Dnieper River. From there, the barges can transport grain to ocean-going vessels at Kherson harbor about 95 kilometers away on the Black Sea.

INTSOY's role in the Ukraine

INTSOY will play a major role in developing a processing plant located near the central storage facility. The plant will produce value-added feed and food products made from corn and soybeans. The soy processing system is based on the extrusion-aided screw press process developed by scientists from INTSOY and the University of Illinois Department of Food Science.

Approximately 30 percent of the grain produced by participating farms will be processed into feed for beef cattle, poultry, and swine. The oil from the process will serve as a value-added commodity for sale to refiners or for direct marketing as edible oil. The partially defatted meal will be added to dry milled corn and then formulated with appropriate additives for animal feed.

The processed livestock feed will be used to improve the production efficiency of existing livestock operations located on the participating farms. The system can easily be adapted to produce full-fat soy flour. Later the system could be expanded to produce other nutritious soy-based products for human consumption.

The four-year project is expected to help reduce postharvest losses of food grain, promote the efficiency of grain utilization, and increase incomes for the participating farms. Most importantly, this project should serve as a model that can be replicated elsewhere in the Ukraine and other newly independent states in Eastern Europe.

New INTSOY Director Named

Wilmot B. Wijeratne has been named as the new director of INTSOY. He succeeds Harold E. Kauffman, who has been on a two-year leave of absence developing a major germplasm storage facility in India with Winrock International. John J. Nicholaides III, director of the Office of International Agriculture, has served as acting director since 1992.

Wijeratne, who moves up from the position of INTSOY associate director, is a native of Sri Lanka. He earned his Bachelor's degree from the University of Peradeniya in Sri Lanka. He holds a Master's degree in Food Technology from the University of Mysore in India. He was awarded his Ph.D. in Food Science at the University of Illinois in 1985.

He has served with INTSOY and the Department of Food Science since 1985, first as a research associate and later as senior food scientist and associate research leader. Since 1990, he has held the position of INTSOY associate director and assistant professor in the Department of Food Science.

Wijeratne comes to the position of INTSOY director with extensive experience working in developing countries. He served as manager for a food research pilot plant and laboratory in Sri Lanka. He also led a major research group in Sri Lanka aimed at developing food products from whole soybeans.

During his tenure at INTSOY, Wijeratne has specialized in development of low-cost extrusion technologies for producing food products from soybeans and cereals. He has traveled extensively in China, Sri Lanka, India, Thailand, the Philippines, Zambia, Vietnam, Brazil, El Salvador, and Egypt. He currently is taking the leadership in developing programs for the new Postharvest Collaborative Agribusiness Support Program.

New Facilities Support Expanded INTSOY Mandate

To help fulfill its expanded mandate, INTSOY has moved into new headquarters facilities at the National Soybean Research Laboratory (NSRL) on the campus of the University of Illinois.

The NSRL is located in a newly renovated building that provides almost 2,700 square meters of sophisticated laboratory and office space. The building stands in close proximity to an extensive greenhouse complex and other major laboratories devoted to soybean research.

The United States Congress allocated US$5 million to cover remodeling expenses for the NSRL. The legislature of the State of Illinois added US$750,000 to equip the facility. The College of Agriculture at the University of Illinois provides administrative staff and basic support for NSRL programs.

A new research facility

The laboratory is situated in the heart of the prime soybean growing region of the United States at the University of Illinois, which has more than 100 individuals engaged in some phase of soybean research. About 50 scientists, graduate students, and support staff are housed in the new laboratory. In addition, the building contains the analytical laboratories for the U.S. Department of Agriculture's national Soybean Germplasm Collection.

Many other University of Illinois researchers outside the laboratory building are involved in NSRL activities. With its broad scope, the NSRL also draws on the expertise of soybean scientists from across the nation and around the world.

As an integral component of the NSRL program, INTSOY has access to a wide range of new facilities, including several conference rooms and a 250-seat auditorium. The auditorium is equipped with sophisticated audio and visual equipment, making it an ideal setting for activities ranging from seminars to major regional conferences.

Two additional offices and a new laboratory for INTSOY were recently added to the plans for the NSRL and are scheduled for completion in 1994. These offices, along with the new headquarters complex, will allow INTSOY personnel to be consolidated in one convenient location. The laboratory will provide upgraded facilities for physical and chemical analysis of soybeans and soy products.

The NSRL program

INTSOY also is working closely with the NSRL to develop new programs that extend far beyond merely managing a new research facility. These programs are designed to encompass research in soybean breeding, genetic engineering, food and nutritional sciences, disease and pest management, animal sciences, marketing, and utilization.

The purpose of the laboratory is too serve as a location where on-site and visiting scientists can work on producer, consumer, and industry problems, ranging from basic genetic research to marketing and processing. The new NSRL program will enable the soybean industry to take full advantage of new technologies in areas as diverse as genetic engineering, telecommunications, and sustainable agriculture.

The NSRL staff work with consumers, farmers, and industry representatives to identify research concerns. The NSRL aids in assembling the research and development teams required to address these concerns and provides a means to create value for the soybean industry and its customers.

Plans already are underway to coordinate INTSOY's extensive training activities with new training courses to be offered at the NSRL during the summer of 1995. Through its contacts with soybean programs in more than 100 countries, INTSOY provides an important international dimension to the new NSRL program. As a result, research programs around the world can be more closely linked in the future with those initiatives that best adapt new ideas and technologies for the benefit of all soybean consumers and producers.

Illinois Congressman Richard J. Durbin (center) joins University of Illinois President Stanley O. Ikenberry (right) and other dignitaries at the official dedication of the National Soybean Research Laboratory. The NSRL provides extensive laboratory, office, and conference space that will enhance INTSOY's role in increasing the use of soybeans and food legumes around the world.

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