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THE CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH

TECHNICAL ADVISORY COMMITTEE

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SOME NOTES ON THE INTERNATIONAL SOYBEAN NETWORK AND INTSOY

(Agenda Item 8)

TAC SECRETARIAT

FOOD AND AGRICULTURAL ORGANIZATION OF THE UNITED NATIONS

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THE INTERNATIONAL SOYBEAN NETWORK AND INTSOY

Introduction

The general goal. The goal of INTSOY is to foster the production of soybeans in tropical and subtropical environments of the LDCs, with particular attention to their use as a highly nutritious food crop by the urban and rural poor.

The soybean provides the highest yield per unit of land area of high-grade protein of any vegetable or animal source. It additionally provides a source of needed vegetable oil and a considerable amount of carbohydrate. Further, in common with other legumes, it can furnish most of its own nitrogen needs through symbiotic Rhizobia bacteria, thus providing particular value when costs of chemical fertilizers have risen beyond the means of many poor farmers to pay for them. Research of the University of Illinois and University of Puerto Rico, under the INTSOY program, has shown that commercial U.S. soybean varieties are capable of providing good yields under tropical conditions although much research in variety development and improving disease and insect resistance and ability to maintain maximum yields under conditions of limited inputs needs to be carried out. This research is one of the functions of INTSOY.

Early economic benefits of soybeans in tropical and subtropical LDCs appear to be particularly good for the small farmer. As a small, but viable, industrial base is developed on soybean production for internal use, the benefits can be expected to increase.

The purpose. The purpose of INTSOY is to assist national efforts, in each country, which aim to change production, marketing, processing, and utilization systems in tropical and subtropical developing countries so as to increase the sustained yield and output of soybeans and, through direct utilization of soybeans for human food, to improve the quality of life of the people in the less-developed countries. Specific objectives are to serve as (1) the hub of an international network for interdisciplinary research, to promote the development and demonstration of improved soybean production and use systems, optimizing the use of human and natural resources in tropical countries; (2) a focal point for training activities which will increase regional competence in a systems approach to a soybean industry (production, processing, marketing, utilization); (3) a multidisciplinary documentation center for the development of soybeans in tropical countries.

In carrying forward its program, INTSOY is developing close linkage with national and regional organizations undertaking research and training activities in the same or closely related fields of interest.

Specifically, it is intended that INTSOY will (1) retrieve, assemble and make available all relevant information on soybean production, marketing, processing and utilization in tropical countries. In many instances, this information will be made available in English and other languages. "Other languages" will include Spanish, French, and perhaps others, depending upon the nature of the material and the priority to make it available in a specific language. (2) Engage an interdisciplinary research staff to study existing production systems (embracing the whole complex of plant, environmental, social and economic factors) and hence to develop new or amended systems of production and define priorities for other research. (3) Support, supplement and cooperate with existing national and regional research stations or programs in developing a fully coordinated program of production, *processing, marketing and utilization research which is related to the urgent needs of more protein. (4) Develop research programs in specific aspects of soybean production, processing, marketing and utilization which are appropriate to an international center. (5) Organize, or assist in organizing, seminars, technical conferences and training courses for staff engaged in soybean research, extension, planning and production; particularly emphasizing the systems approach to soybean research and development. (6) Make available statistical support, information or advise to national, regional or international authorities in the various fields relating to a soybean industry in which the center is actively engaged. (7) Engage in such other activities as may be found necessary to the furtherence of its objectives.*

General program activities. This section describes the activities that are projected in the fields of research, documentation and information services, and training.

It is the unique characteristics of INTSOY that all research, and much of the other work of the program, is to be based on the interdisciplinary approach of a total soybean program. There will be no case for an international soybean center or resource base if that center were to engage simply in single discipline research. If international agencies and other donors wish only to sponsor additional discipline-oriented soybean work, there are several research establishments that could provide facilities for such work. The one new dimension that an international soybean network can provide, to supplement and complement existing capabilities, is a multidisciplinary team that can study problems and their solutions within a systems context.

Emphasis will be placed on the total balanced program of research and education in soybean production, processing, marketing, and utilization. The soybean production component will be integrated with a farming system.

Even though INTSOY is oriented around one specific crop, soybeans, it will not be adequate to concentrate simply on breeding improved genetic material. The "total approach" concept, including breeding and other phases of production, as well as processing, utilization and marketing will be emphasized throughout. It will need to spread its research education and development activities. It will be a decentralized "center." It will build on the strengths of existing and developing national and international organizations.

Even though the procedure for established associative or cooperative programs are not yet completely defined, they should be flexible and fully coordinate with other research by national institutions and appropriate to the large range of situations throughout tropical countries.

In such programs, INTSOY will be acting as a catalyst inducing cooperators to undertake, with INTSOY's help, complementary programs with coordinated and uniform methodology in a more rapid development of information.

In associated programs, INTSOY will cooperate by providing small research teams to work in association with national research teams for the solution of problems of wide and important interest for the region. Such cooperative work will be mutually planned and agreed to by agreement between INTSOY and national or regional institutions. The INTSOY core program (resource base) will not be confined only to the headquarters but parts of it will be conducted in regions with INTSOY influx of staffing, financing, and publication.

In support of the activities described, INTSOY will maintain a central research staff and such other "project" or contact staff as the cooperative program requires. The later requirement depends, in turn, on the funds available and the extent of the demand.

The "resource base" will be concerned primarily with the study of soybean production, processing, marketing, and utilization and the design and supervision of research projects emanating therefrom. There is provision on the team for plant breeders, production agronomists, physiologists, pathologists, entomologists, economists, food processing engineers, food scientists, extension specialists, microbiologists, soil fertility specialists, and agricultural communication specialists. They will travel widely. They will be based in Urbana, Illinois and Mayaguez, Puerto Rico along with all data storage, computing facilities, library facilities, laboratory facilities and experimental field plots.

Additional information on INTSOY is found in:

1. *INTSOY Newsletter No. 1, August 1974, "What Is INTSOY?"*

2. *"A Need for an International Network in Tropical Soils. III. Soybean Research Network." By Omer J. Kelley. Pp. 544-558. In Soil Management in Tropical America. Edited by E. Bornemisza and A. Alvarado. Proceeding of a seminar held at CIAT, Cali, Colombia, February 10-14, 1974.*

A Brief Outline Summary of Progress, 1973-1976

This is a brief outline summary of the progress of INTSOY for the 1973-1976 period. There were earlier activities that led to the University of Illinois and University of Puerto Rico commitment to establish INTSOY in July 1973. The University of Illinois/USAID supported work in India that was coordinated with agricultural university development programs showed the potentials for soybean production and use for human food. AID and Rockefeller Foundation support during the July 1, 1971-March 31, 1973 period provided for demonstration and technical service activities on a broader geographical basis. Such projects, the long-standing interests of the two universities in soybeans and other food legumes, and interests in making a contribution to expanded and more efficient production and use of food led to the commitment to establish INTSOY with objectives similar to the international agricultural research centers. A meeting of representatives of foundations, national, and international organizations on July 9-10, 1973 confirmed the need for and validity of the general plan for program and organization. The Technical Advisory Committee of the Consultative Group for International Agricultural Research has supported the general concepts underlying INTSOY as a means of bringing developed country research, education, and development capacity to bear on the world food problem.[1/]

While INTSOY has not yet been supported in a way to permit potentials to be fully realized, the support provided by the two universities, many individual countries, USAID, Rockefeller Foundation, and UNDP/FAO in one country has permitted excellent progress to be made.

Basic program support

1. *AID Research Contract (AID/CM/ta-c-73-19) $980,000 for three years ending March 31, 1976. Support for work in soybean breeding and*

1/ For more detail on the concepts, program, and administration see University of Illinois, International Agricultural Programs, "International Soybean Resource Base, A Proposal," June 1973, 79 pages.

agronomy, pathology, entomology, and soybean foods. USAID approved a new research contract for three years beginning April 1, 1976 in the amount of $2,085,855.

2. *AID 211(d) Grant to University of Illinois (AID/CM/ta-g-73-49) $500,000 for five years ending September 30, 1978. Emphasis on soybean breeding under tropical conditions. Revision and request for expansion before AID to emphasize building institutional response capability.*

3. *AID 211(d) Grant to University of Puerto Rico (AID/CM/ta-g-73-49) $500,000 for five years ending September 30, 1978. Emphasis on soybean protection areas, particularly pathology. Revision and request for expansion before AID to emphasize building institutional response capability and broaden crop protection areas covered.*

4. *Rockefeller Grant (one-year $100,000 grant for year ending July 31, 1975). Main purpose to support tropical soybean production research centered at Puerto Rico including seed storage under tropical conditions.*

INTSOY publication series. The INTSOY publications series has added to the joint UIUC and UPR-MC soybean response capability as well as provide a means of making research results readily available to those interested in tropical and subtropical production and use of soybeans. Ten publications have either been issued or are in final stages of production. They include:

1. *Godfrey, G. L. (ed.), Selected Literature of Soybean Entomology, University of Illinois International Agriculture Publications, INTSOY Series No. 1, 221 + xxi pp. April 1974.*

2. *Proceedings of the Workshop on Soybeans for Tropical and Subtropical Conditions. University of Puerto Rico, Mayaguez Campus. INTSOY Series No. 2. 184 pp. May 1974.*

3. *Williams, S. W. and Rathod, K. L., A Case Study of Expeller Production of Soybean Flour in India. College of Agriculture, University of Illinois at Urbana-Champaign. INTSOY Series No. 3. 12 + iii pp. April 1974.*

4. *von Oppen, M. K., Soybean Processing in India: A Location Study on an Industry to Come. College of Agriculture, University of Illinois at Urbana-Champaign. INTSOY Series No. 4. 35 pp. July 1974.*

5. *Williams, S. W., Hendrix, W. E., and von Oppen, M. K., Potential Production of Soybeans in North Central India. College of Agriculture, University of Illinois at Urbana-Champaign. INTSOY Series No. 5. 21 + iv pp. August 1974.*

6. *Whigham, D. K. (ed.), Soybean Production, Protection and Utilization--Proceedings of a Conference for Scientists of Africa, the Middle East, and South Asia. College of Agriculture, University of Illinois at Urbana-Champaign. INTSOY Series No. 6. 266 pp. March 1975.*

7. Sinclair, J. B. and Dhingra, O. D., An Annotated Bibliography of Soybean Diseases, 1882-1974. College of Agriculture, University of Illinois at Urbana-Champaign. INTSOY Series No. 7. 280 pp. December 1975.

8. Whigham, D. K., International Soybean Variety Experiment, First Report of Results. College of Agriculture, University of Illinois at Urbana-Champaign. INTSOY Series No. 8. 161 pp. October 1975.

9. Hymowitz, T., Carmer, S. G., and Newell, C. A., Soybean Cultivars Released in the United States and Canada: Morphological Descriptions and Responses to Selected Foliar Stem and Root Diseases. College of Agriculture, University of Illinois at Urbana-Champaign. INTSOY Series No. 9, 31 pp. January 1976.

10. Goodman, R. M. (ed.), Expanding the Use of Soybeans, Proceedings of a Conference for Asia and Oceania, College of Agriculture, University of Illinois at Urbana-Champaign, INTSOY Series No. 10 (in process).

The INTSOY Newsletter. The INTSOY Newsletter is intended to provide communication among those interested in soybeans on a world scale. It was first issued in August 1974 and is released quarterly. The first mailing was to about 500. Requests for names to be added have resulted in expansion of the mailing list to 1,200. The latest INTSOY Newsletter, No. 7, was printed in February 1976. All INTSOY Newsletters are attached.

Training programs and conferences. In cooperation with the United States Department of Agriculture's Office of International Training and USAID, two short-term applied training courses have been developed to provide a general experience to soybean workers, or those interested in soybean development, from other nations. One course, Soybean Processing for Food Uses, has completed two successful sessions. A second course, Technical and Economic Aspects of Soybean Production, completed its first session in summer of 1975 and commenced its second session May 5, 1976.

The general development objectives of the soybean processing course are to give participants the opportunity to learn the principles and processes involved in use of soybeans and soybean products for human foods, to teach the concepts and procedures for processing of whole soybeans, and then apply the knowledge gained to country development objectives in the use of soybeans as an improved source of protein and calories. The first course welcomed 13 persons from ten different countries. Participating in the course were Luis E. Zapata M. (Colombia), Ricardo R. Del Rosario (Philippines), Jae Heung Lee (Korea), Decio A. Travaglini (Brasil), Alfredo Lam-Sanchez (Brasil), Camilo Antonio Rozo (Colombia), John F. Okorio (Kenya), Mrs. Chandra Breckenridge (Sri Lanka), Mrs. Susana Mahamah (Ghana), Ana V. Roman (Costa Rica), Pracha Boonyasirikool (Thailand), Jonathan K. Quartey (Ghana), and Ariel Espinoza Correa (Nicaragua).

Fifteen participants from 12 countries recently completed the second session of the course. They included Abu Fazal Md. Asafzah (Bangladesh), Mohammad Nabi Aslamy (Afganistan), Abdoul Hamid Anwar Borai (Egypt), Wen Lian Chen (Republic of China), Jorge Duran (Colombia), Fernando Moreno (Colombia), Ahmad Nabavi (Iran), O. O. Onyekwere (Nigeria), Mohamed Aly Shaker (Egypt), Shreepati Sharma (Nepal), Joao S. Tango (Brasil), Alejandro Uribe-Peralta (Colombia), Kailash Vyas (India), W. B. Wijaratne (Sri Lanka), and Maria Cristina Zulueta (Peru).

While the course in soybean processing is an intensive five-week experience, the course on Technical and Economic Aspects of Soybean Production is of longer duration, approximately four months, and carries through the major part of the soybean growing season. The general developmental objectives are: to learn the technical and economic principles and practices of soybean production; to study the research, educational and regulatory functions supportive of a soybean industry; to understand the potential use of soybeans to alleviate protein-calorie deficiency problems; and to increase participant's knowledge and understanding of the basic nature and characteristics of the soybean plant, the cultural practices required for its production, factors affecting seed quality, and the adaptation of the technology required for soybean production to local conditions. The first course, given May-August 1975, welcomed 16 persons from 15 different countries. Participating in the course were Simin Amindari (Iran), Conrado R. Bartolome (Philippines), Miguel Z. 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), 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). For the 1976 session of the "production" short course, approximately 18 persons from 9 countries are expected.

Planning is now underway to offer a condensed version of the soybean production short course and is now being developed to be offered at selected overseas location. The general objectives will be to provide course participants with an adequate understanding of the soybean crop and its management needs to be able to successfully grow the crop, to recognize the production hazards, and to evaluate the consequences of these hazards in terms of soybean productivity and quality. USDA's Office of International Training is cooperating in the development of the course which may be offered sometime in 1977.

A successful blend of informal training and professional interchange has been a central feature of three INTSOY-sponsored regional soybean conferences. One each has been held for soybean workers in the Latin America-Caribbean region; for workers in Africa, the Middle East and South Asia and for workers in Asia and Oceania. The general purpose of each seminar was to bring scientists together to consider the potential of soybeans as a major world food crop. The theme of each 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.

Each conference was well attended. The first conference, held February 4-6, 1974 on the University of Puerto Rico Mayaguez Campus, had 71 participants from 12 countries. The second conference held October 14-17, 1974 at Addis Ababa, Ethiopia, attracted 97 participants from 24 countries. The most recent conference was held February 23-27, 1976 in Chiang Mai, Thailand and attracted 225 participants from 21 countries.

General sessions were devoted to the presentation of scientific papers on various aspects of production, protection, utilization and economics. Some conferences featured symposia focusing on special problems associated with soybean production, protection, or use. Field trips to experiment stations and farms were a feature of each conference.

These conferences have been very effective as a means of encouraging exchange of ideas and information among soybean workers across national lines. The proceedings (INTSOY Series 2, 6, and 10) are constantly being requested.

Training courses and conferences are supplementary to degree work available at the University of Illinois and University of Puerto Rico and many other universities with soybean expertise.

The combination of the publication series, INTSOY Newsletter, training courses, and conferences has exceeded all expectations as a means of bringing national organizations, international research centers, and individuals into the international soybean network.

Country programs. *Assistance on country programs has been provided through support of the individual countries, AID, and UNDP/FAO.*

1. *Soybean Development in Sri Lanka (the largest country program) supported by UNDP and FAO. This is a $682,000 project for 30 months beginning April 1, 1975 but anticipated to be extended for an added five years from November 1, 1977.*

   The first phase of the project calls for 81 man months of technical assistance, 187 man months of training of Sri Lanka personnel and a modest equipment budget. Technical assistance is being provided in the areas of agronomy, plant breeding, plant pathology, entomology, cost of production and marketing, processing, food science (utilization), agricultural engineering, and weed control. An INTSOY Proposal for the Establishment of a Pilot Plant Research Facility for Development of Soybean Food Products and Processes, which is an ancillary project of the Sri Lanka/UNDP/FAO/INTSOY contract, is presently under consideration by several agencies.

2. *AID Mission supported country programs under the AID Basic Ordering Agreement-Task Order format.*

   a. *AID/BOA-73-30 Task Order #1, Guyana (completed)--10.5 man months service).*

      Technical assistance was provided in the areas of agronomy, plant breeding, cost of production and marketing, seed technology, microbiology, processing (separation of oil and protein), and food science (utilization).

   b. *AID/BOA-73-30 Task Order #2, Uruguay (completed)--.5 man months service).*
   c. *AID/BOA-73-30 Task Order #3, Peru (completed)--.25 man months service).*
   d. *AID/BOA-1109 Task Order #1, Bangladesh (completed)--.75 man months service).*
   e. *AID/BOA-1109 Task Order #2, Peru (in progress)--22 man months service).*

      Technical assistance is being provided in the areas of agronomy, plant breeding, extension, microbiology, cost of production and marketing, and food science (utilization). The Peruvian Government has requested a long-term contract with technical assistance, training of local personnel and equipment components--for the development of a total soybean program.

f. AID/BOA-1109 Task Order #3, Ecuador (in progress)--45 man months service). Plant breeding and agronomy.
g. AID/BOA-1109 Task Order #4, Zaire (completed)--1 man month service).
h. AID/BOA-1109 Task Order #5, Thailand (in progress)--3 man months service).

   To assist the Government of Thailand in deciding whether they should develop their capability to produce soybean inoculum or import it.

3. Country support only

   a. Saudi Arabia--two-man team to study soybean potential.
   b. Ivory Coast--support for degree training at the University of Illinois and for University of Illinois and Mississippi State University personnel to advise on soybean development in Ivory Coast.

Formalized Linkages with National and International Organizations

INTSOY has demonstrated that administrative mechanisms can be developed for cooperation with national and international organizations. One effective means is the general Memorandum of Understanding with Letters of Agreement to provide for specific projects and activities. The flexibility of this mechanism should be noted. Memoranda of Understanding have been completed with the following organizations:

1. University of Puerto Rico, Mayaguez Campus. This is the primary relationship in INTSOY providing for joining of the temperate and tropical based universities.

2. International Institute of Tropical Agriculture (IITA), Nigeria. This provides a means for INTSOY to work with and through an international center with soybeans as part of their mandate. It is anticipated that an INTSOY research and outreach team, fully integrated with the IITA Grain Legume Improvement Program staff, will be based at IITA. However, separate funds of implement work under this Memorandum have not yet been identified.

3. Asian Vegetable Research and Development Center (AVRDC), Taiwan. General objectives are similar to IITA.

4. Fundacao Instituto Agronomico do Parana (IAPAR), Brasil. This provides the opportunity to join with the second most important soybean-producing country to expand the use of soybeans for human food, both there and in low-income countries of the tropics and subtropics. The recent location of the National Soybean Center at IAPAR provides expanded opportunities for cooperative efforts in serving the needs of tropical and subtropical countries, particularly in South America.

5. Office of Rural Development, Ministry of Agriculture and Fisheries, Korea. Korea has had significant experience in soybean production and has an aggressive crop development program that includes soybeans. Cooperation here is planned as a technological bridge between the temperate and tropical areas of the Orient and Asia.

6. *College of Agriculture, University of Tehran, Karaj, Iran and College of Agriculture and Animal Husbandry, Rezaiyeh, Tehran. Memoranda of Understanding have been completed with these two colleges of agriculture and discussions are well advanced with other Iran organizations. The objective is to develop cooperative research, education, and development work on expanded use of soybeans and production under irrigated conditions typical of Middle East and other similar conditions.*

7. *Philippines Council for Agriculture and Resource Research. A Memorandum of Understanding is under consideration to provide for cooperative research.*

Discussions are underway with personnel of other organizations including additional international centers, such as CIAT, with interests in soybeans because of the crop being part of their mandate, relations between soybeans and other legumes, and farming systems in which soybeans have a place.

Outreach locations--some examples. The relationship with IITA illustrates the way in which INTSOY can relate to international centers (as well as national organizations) in developing an effective international soybean network.

An outreach location in Africa could greatly expand the production and use of soybeans in that part of the world. A team of INTSOY scientists located at a place such as IITA could make much progress in developing cultivars better adapted to low latitude environments for production and use.

As show in a later section, the soybean variety testing work of IITA and INTSOY for Africa has been fully coordinated and integrated. Agreement has been reached to locate an INTSOY breeder/agronomist at IITA. This is seen as the first step toward a soybean team that is likely to be one or two breeders, an agronomist, a pathologist, and a scientist responsible for the regional outreach activities of the team. The team would require support from entomologists, weed scientists, microbiologists, and other specialists.

With its interests in grain legumes, there is the potential for a complementary relationship between CIAT and INTSOY providing an outreach location for part of Latin America. A team, along the lines suggested for Africa, at CIAT would be required. CIAT is also a possible location for a cooperative Rhizobium research and training center and pilot plant facility. Nitrogen fixation has never been more important than now. Research oriented to the tropics and a training center are needed. Rhizobium research and training and inoculant production are vital to soybeans, field beans and pasture legumes and microbiologists from INTSOY and CIAT could develop this center. Discussions have also been held to investigate a cooperative seminar for experimental design and interpretation of results between INTSOY and CIAT. The seminar would provide a review and upgrading of scientists in Latin America. Cooperators of INTSOY and CIAT programs would be encouraged to participate. Such participation would strengthen both national and international research activities.

Other INTSOY Linkages

INTSOY has a host of relations with organizations and individuals demonstrating a basic organizational concept of cooperation with all who have interest congruent with our mission "to expand the use of soybeans for human food."

The following is a list of these organizations.

1. *Organizations in 90 countries through the International Soybean Variety Experiment (ISVEX). (Also see Appendix A and Appendix B.) The ISVEX has been distributed and tested in many parts of the world in cooperation with several international agencies.*

   a. *FAO--INTSOY has provided the ISVEX to the Food and Agriculture Organization of the United Nations for testing in numerous Middle East and North African countries over the past four years.*
   b. *IRAT--During 1975, the Institut de Recherches Agronomiques Tropicales et des Cultures Vivrieres, Paris, cooperated with INTSOY to test the ISVEX in 11 countries of Africa and Mesoamerica.*
   c. *IRRI (International Rice Research Institute) has been cooperating for four years with INTSOY by testing the ISVEX in Indonesia as part of the outreach multiple cropping activities. IRRI and INTSOY cooperated in a similar manner in Sri Lanka during 1973 and 1974.*
   d. *In 1975, SEARCA (Southeast Asia Regional Center for Graduate Study and Research in Agriculture) and INTSOY prepared a joint variety trial for testing in Southeast Asia. Nine entries were provided by SEARCA and eight came from INTSOY. Results of these experiments were shared by both organizations and the cooperating country.*
   e. *IITA (International Institute of Tropical Agriculture, Ibadan, Nigeria) and INTSOY have initiated a joint variety trial which is being distributed for the first time in 1976 to approximately 30 countries in tropical Africa. Each organization provides eight cultivars for the INTSOY/IITA trials.*

2. *Nitrogen Fixation by Tropical Agricultural Legumes (NIFTAL), University of Hawaii/AID (microbiology, Rhizobium japonicum, etc.).*

   When soybeans are introduced into new areas it is of vital importance to also introduce highly effective strains of Rhizobium japonicum, the bacteria that produce nodules on the soybean plant and convert free atmospheric nitrogen into a form which can be used by the plant (symbiotic nitrogen fixation). INTSOY will have a strong component in Rhizobial microbiology and will assist in setting up national and regional "pilot plant" operations for inoculum production and training. However, INTSOY will not duplicate Rhizobial research, training and outreach activities of other centers. INTSOY and NIFTAL already have close linkages and will cooperate on numerous programs to avoid duplication and to provide more efficient and effective approaches.

3. *USDA Regional Soybean Laboratory at Urbana, Illinois and Stoneville, Mississippi. INTSOY does not have its own germplasm bank. For many years, the World Germplasm Soybean Collection has been most adequately maintained, evaluated and disbursed by the USDA Regional Soybean Laboratory at Urbana, Illinois and Stoneville, Mississippi. INTSOY has strong cooperative linkages with the Regional Soybean Laboratory and will continue to rely on and assist the Laboratory relative to germplasm. The tropical and subtropical germplasm will be maintained by an extension of the proven system of the Regional Laboratory.*

4. *Kansas State University, Food and Feed Grain Institute.*

5. Seed Technology Laboratory, Mississippi State University.

6. University Consortium on Soils of the Tropics (Cornell University, University of Hawaii, North Carolina State University, Prairie View A & M College, University of Puerto Rico).

7. North Carolina State University--NCSU/AID root-knot nematode project.

8. U.S. university personnel on Task Orders and other projects--Iowa State University, Purdue University, Texas A & M University, University of Florida, and Cornell University.

9. Private sector employees on Task Orders and other projects--Swift and Company, Potash Institute of North America, Agricultural Laboratories, Inc., and Research Seeds, Inc.

10. International Board for Plant Genetic Resources (IBPGR) has suggested that INTSOY coordinate soybean germplasm collection activities throughout the world. It is imperative that germplasm collections be made in some countries in the near future to prevent genetic erosion (loss of genotypes).

Production Potential of Soybeans in Tropical and Subtropical Environments

Information from INTSOY varietal trials (ISVEX), which have been conducted since 1973, clearly indicates that soybeans do have high production potential at many tropical locations when grown under climatic conditions that are favorable to the growth, development and harvesting of soybeans (Appendix A). It is emphasized that most of the varieties thus far tested in ISVEX trials are U.S. varieties which, theoretically at least, might not be well adapted to low latitudes. The fact that many varieties produce acceptable yields indicates that these varieties can be used until improved tropical varieties have been developed. It also suggests that tropical soybean breeding programs, such as the one which INTSOY has in Puerto Rico, will be able to generate new improved varieties which are higher yielding, and superior in other characteristics, to varieties presently in the trials. The salient features of the INTSOY genetic improvement program are indicated in INTSOY Newsletter No. 7.

Screening for Daylength Sensitivity

In wheat and rice breeding programs for tropical and subtropical environments, considerable progress has been made by the development of photoperiod insensitive (day neutral) genotypes. The soybean is highly photosensitive and is a short-day plant; that is, most genotypes will flower more rapidly under short-day conditions than under longer photoperiods. Varieties adapted to higher latitudes flower and mature more rapidly in the lower latitudes, while flowering and maturity of genotypes adapted to lower latitudes are delayed if they are grown in higher latitudes.

Day neutral soybean genotypes have been reported in some of the earliest maturing lines (maturity groups 00 and 0). INTSOY has recently field screened (at Urbana, Illinois and Isabela, Puerto Rico) most accessions from maturity Group III of the USDA soybean germplasm collection. Of 515 genotypes screened, one line, PI 317.334B (Kitami Shiro), was identified as possessing unique photoperiod *insensitive properties. It remains to be seen how valuable this apparent photoperiod insensitivity of Kitami Shiro will prove to be. In Puerto Rico, the INTSOY plant breeder has made a series of crosses using the insensitive plant introduction and a diverse group of cultivars as parents to study the inheritance of insensitivity and its genetic relationship with other characters, especially maturity. This insensitivity will be of limited value if it cannot be transferred into varieties that are later maturing and higher yielding than Kitami Shiro.*

Soybean Seed Quality and Storage Research

Appendix C presents some of the details of a Soybean Seed Quality Trial. This is only one example of the experiments initiated on seed quality.

See INTSOY Newsletter No. 6 for more information on soybean seed storage research.

Entomological Pest Management Program

See INTSOY Newsletter No. 3.

Soybean Pathology

See INTSOY Newsletter No. 4.

Utilization of Whole Soybeans as Human Food

This work is summarized in INTSOY Newsletter No. 5. See Appendix D for references on use of whole soybeans for food.

The INTSOY Professional Staff

INTSOY staff are located primarily on the University of Illinois Urbana-Champaign Campus or the University of Puerto Rico Mayaguez Campus. Effective July 1976 an INTSOY representative for Asia will be posted in Sri Lanka. With the development of program and resources, INTSOY staff will be increasingly assigned to other countries.

Members of the INTSOY professional staff include: William N. Thompson, Director; Raul Abrams, Associate Director; Carl N. Hittle**, Senior Agronomist and INTSOY Representative for Asia; Thomas A. McCowen, Assistant Director; Robert E. Dunker, Assistant Agronomist, Field Trials; Michael Ellis*, Soybean Pathology; Leslie K. Ferrier, Food Science, Variety Improvement; Robert M. Goodman, Soybean Pathology, Virology; M. E. Irwin, Pest Management; Pedro L. Melendez*, Soybean Pathology, Fungal; Harry C. Minor, Agronomist, SPOT Program; Alvin I. Nelson, Food Science, Processing; E. H. Paschal*, Plant Breeding; Eliodoro J. Ravalo*, Agricultural Engineering, Storage; Guillermo Riveros*, Soybean Pathology; Errol D. Rodda, Agricultural Engineering; James B. Sinclair, Soybean Pathology, Fungal and Bacterial; D. K. Whigham, Agronomist, ISVEX Program; and S. W. Williams, Agricultural Economist, Marketing and Processing.*

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*Located at the University of Puerto Rico.
**Effective July 1, 1976 located at Central Agricultural Research Institute, Gannoruwa, Sri Lanka.

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Appendix A

ISVEX -- International Soybean Variety Evaluation Experiment

The International Soybean Variety Evaluation Experiment (ISVEX) was initiated in 1973 as a part of INTSOY. ISVEX is the first step of a breeding program to identify adapted germplasm and desirable plant characteristics for improving soybean production and utilization in the tropics and subtropics. Information from ISVEX was utilized by the INTSOY plant breeding section for varietal improvement. The objectives of ISVEX are to: (1) test the adaptation of soybean cultivars under a wide range of environmental conditions; (2) provide research workers an opportunity to compare local and introduced cultivars; (3) provide a source of new germplasm which cooperators may use directly or incorporate into breeding programs; (4) identify areas of the world that have a potential for soybean production; and (5) evaluate the response of the soybean to different environments.

The cultivars were evaluated in a randomized complete block design with four replications. Each plot consisted of four rows spaced 60 cm apart. Rows were 6m long in the first (1973) ISVEX but reduced to 5m for the second (1974) ISVEX. Five meters of the two center rows were harvested in both experiments. A plant population of 400,000 plants/ha was desired.

General information about the site and the experiment was provided by the cooperator including latitude, altitude, soil conditions, dates of planting and harvesting, amount of moisture, fertilizer used, local cultivars tested, and pests of the environment. Data from individual plots was provided for several agronomic characteristics including yield (kg/ha); 100 seed weight; days to flower, days to maturity; plant height at maturity; and pods per plant.

<u>Experiment Sites</u>

The experiments were tested in a wide range of environmental conditions representing the latitude range of 30° S to 35° N and altitude from 9m to 1803m for the first ISVEX. The second ISVEX represented environments of 27° S to 40° N latitude and from 0 m to 1850 m altitude. Environment dictated the optimum planting time for each site. Several sites tested the experiment in more than one season of the year. Table 1 identifies those countries represented in the first and second ISVEX.

The test sites were divided into environmental zones determined by units of 10° latitude and 500m altitude, to identify a reasonable limit to the environmental range.

Data from the first (1973) ISVEX was received from 60 sites in 27 countries. The experiment included 20 cultivars of soybean from various regions of the United States. The cultivars represented a wide range of genotypic and phenotypic characteristics as well as some resistance to known pests. Cultivars from other countries were not utilized due to lack of a seed supply. One or more local cultivars were substituted into the experiment at many sites to compare their performance level. The second (1974) ISVEX which tested 15 cultivars, produced data from 86 sites in 39 countries. Each site received the same set of cultivars for testing each year.

The third (1975) ISVEX was conducted at 245 sites in 90 countries, ranging in latitude from 35° S to 45° N and in altitude from 0 to 2,000 meters. A list of ISVEX cooperators for 1975 is attached as Appendix B.

Highlights of ISVEX Results

During 1974, ISVEX was tested at 17 sites, with altitudes less than 500m during two seasons, in Sri Lanka. The variety Davis produced the highest mean yield of 2,228 kg/ha, followed by Bossier, Hardee, Improved Pelican and SJ-2 with yields above 2,000 kg/ha. All five varieties matured in 90 to 93 days from emergence and ranged in plant height, at maturity, from 30 cm (Davis) to 60 cm (Improved Pelican).

The highest mean yield from six sites between the equator and 10^{o} latitude and less than 500m altitude in Africa was 1,782 kg/ha by Bossier during 1974. Bossier had a mean plant height of 41 cm and matured in 96 days.

In Mesoamerica during 1974, the highest mean yield was 2,425 kg/ha when combining 13 sites between 10^{o} and 20^{o} latitude and less than 500m altitude. Bossier was again the highest yielding variety followed by Jupiter, Davis, Williams, and Clark 63. Plant height ranged from 40 cm (Davis) to 72 cm (Jupiter) and days to maturity ranged from 92 (Williams) to 124 (Jupiter).

Bolivia tested the experiment at five sites between 10^{o} and 20^{o}S and less than 500m in 1974. The highest mean yield was 2,996 kg/ha for Jupiter which matured in 120 days and was 68 cm tall. Bossier and Davis produced yields which were not significantly less than Jupiter.

Eight South American sites within 10^{o} of the equator and less than 500m had a high mean yield of 3,359 kg/ha. Jupiter was the highest yielding variety followed by Bossier. Jupiter matured in fewer days (107) at the lower latitude, but grew taller (73 cm).

TABLE 1. Countries where the first/ 1973 and second/ 1974 International Soybean Variety Evaluation Experiments were tested.

REGION	COUNTRY	ISVEX NUMBER
Africa	Angola	2
	Cameroon	2
	Egypt	1 and 2
	Ethiopia	1 and 2
	Ghana	1 and 2
	Ivory Coast	2
	Lesotho	1
	Nigeria	2
	Rhodesia	2
	Sierra Leone	1 and 2
	Somalia	1
	Swaziland	2
	Tanzania	1
	Zambia	2
Asia	Afghanistan	1 and 2
	India	1 and 2
	Indonesia	1 and 2
	Malaysia	1 and 2
	Nepal	2
	Pakistan	1 and 2
	Philippines	1 and 2
	Sri Lanka	1 and 2
	Taiwan	1 and 2
	Thailand	1 and 2
	Vietnam	1
Europe	Spain	2
Mesoamerica	Belize	1
	Costa Rica	1 and 2
	Dominican Republic	2
	El Salvador	2
	Mexico	1 and 2
	Nicaragua	1
	Panama	2
	Puerto Rico	1 and 2
	Trinidad	2
Middle East	Iran	2
	Israel	2
	Jordan	1 and 2
	Lebanon	2
	Saudi Arabia	2
	Syria	1
South America	Bolivia	2
	Colombia	1 and 2
	Ecuador	1 and 2
	Guyana	2
	Venezuela	2

Appendix B

List of International Soybean Variety Evaluation

Experiment (ISVEX)-No. 3 Cooperators for 1975

Region	Country	Name	Address
AFRICA	Algeria	The Officer-in-Charge	Station Experimentale I.N.R.A.A. Khemis-Miliana El-Asman, ALGERIA
	Burundi	Mr. E. Sebatutsi	Director General ISABU B.P. 795 Bujumbura, BURUNDI
	Cameroon	Dr. H. D. Drechsler	Director Wum Area Development Authority Wum via Bamenda P.O. Box 13 CAMEROON
		Monsieur le Directeur de l' IRAT/Cameroun	Boite Postale 2 123 Yaounde-Messa CAMEROON
	Central Africa	Mr. Emilein Lefort	Project Manager FAO, CAF/72/006 c/o Resident Representative UNDP P.O. Box 872 Bangui, REPUBLIC OF CENTRAL AFRICA
	Chad	Dr. Bernhard Kraft	Ing. Agr. SWISSAID B.P. 1113 N'Djamena, CHAD
	Congo	Ing. Ivetic Obrad	Expert de la FAO BT. 3 Lekana Brazzaville, CONGO
	Dahomey	Mr. R. Dumont	IRAT BP. 155 Parakou, DAHOMEY
	Egypt	Dr. Ali Abdel-Aziz	Head, Grain Legume Research Section Field Crops Research Institute Agricultural Research Centre Giza, EGYPT
	Ethiopia	Mr. Abdurahman Ali	Institute of Agricultural Research Bako Research Station P.O. Box 3 Bako, ETHIOPIA

Region	Country	Name	Address
AFRICA	Ethiopia	Mr. Zewudu Oumer	Agronomist Awassa Experiment Station P.O. Box 16 Awassa, Sidamo, ETHIOPIA
	Gambia	Dr. L. J. Marenah	Director of Agriculture Department of Agriculture Cape St. Mary THE GAMBIA
	Ghana	Dr. Bob Dadson	Department of Crop Science Faculty of Agriculture University of Ghana Legon, GHANA
		Mr. Hector Mercer-Quarshie	Crops Research Institute P.O. Box 3785 Kumasi, GHANA
	Ivory Coast	Dr. Assa Ayemou	B. P. 4322 Abidjan, IVORY COAST
	Kenya	Mr. A. Mohammed Amiyo	Oil Seed Research Project Ministry of Agriculture Department of Techincal Services National Horticultural Research Station P.O. Box 220 Thika, KENYA
	Lesotho	Mr. J. Broadhurst	Project Manager Senqu River Project Mohale's Hoek LESOTHO
		Mr. Chu Chen-kien	P.O. Box 789 Maseru LESOTHO
	Liberia	Mr. Andrew Paye	Ministry of Agriculture Monrovia, LIBERIA
		Mr. Y. O. Tzou	Central Agricultural Experiment Station Suakoko, Bong County Ministry of Agriculture LIBERIA
	Malawi	Dr. O. T. Edje	Crop Production Department Bunda College of Agriculture University of Malawi P.O. Box 219 Lilongwe, MALAWI

Region	Country	Name	Address
AFRICA	Mali	Monsieur le Chef de la Mission IRAT au Mali	Boite Postale 438 Bamako, REPUBLIC OF MALI
	Mauritius	Dr. A. L. Owadally	Divisional Scientific Officer Government of Mauritius Ministry of Agriculture and Natural Resources Reduit, MAURITIUS
	Niger	Mr. J. Charoy	Station de Tarna INRAN B.P. 6 Maradi, NIGER
	Nigeria	Mr. H. A. Rheenen	Officer-in-Charge Mokwa Agric. Research Station P.M.B. 101, Mokwa, via Jebba, NIGERIA
		Mr. N. O. Afolabi	I.A.R.T. P.M.B. 5029 Moor Plantation Ibadan, NIGERIA
	Reunion	Mr. R. Dadant	le Directeur de l'IRAT/Reunion Agence de la Reunion Ile de la Reunion 97487 St. Denis, REUNION
	Rhodesia	Dr. J. R. Tattersfield	Legume Breeder 4 Wendy Drive Belvedere Salisbury, RHODESIA
	Rwanda	Mr. A. Camerman	Chef dy Groupe des Plantes vivrieres de l'ISAR ISAR, Institut des Sciences Agronomiques du Rwanda Station de Rubona B. P. 138 Butare REPUBLIQUE RWANDAISE
	Senegal	Directeur	Institut Senegalais de Rechershes Agricolas (ISRA) Bambey, SENEGAL
	Sierra Leone	Mr. S. M. Funnah	Njala University College Faculty of Agriculture Private Mail Bag Freetown, SIERRA LEONE
	Somalia	Mr. M. A. Dukseyeh	Head, Agricultural Research Service Ministry of Agriculture Central Agricultural Research Station - Afgoi Magadishu, SOMALIA

Region	Country	Name	Address
_.FRICA	Sudan	Director General	Agricultural Research Corp. Gezira Research Station Wad Medani Blue Nile Province, SUDAN
	Swaziland	Mr. C. E. Brook	Chief Research Officer Malkern's Research Station P.O. Box 4 Malkern's SWAZILAND
		Mrs. Janet Cumberland	Crop Agronomist, P.O. Box 4 Malkerns, SWAZILAND
	Tanzania	Dr. Brockman	Legume Agronomist ARI, Ilonga Private Bag, Kilosa TANZANIA
		Mr. K. D. Edwards	Agronomist Tanganyika Wattle Co. Ltd. Private Bag Njombe, TANZANIA
	Togo	Monsieur le Chef de la Mission IRAT au Togo	Boite Postale 1163 Lome, TOGO
	Tunisia	Mr. Ahmed Jouhri	Chief of the Oil Seed Research Section INRAT Tunis, TUNISIA
		Mr. Sta-M'Rad	Director, Institut National de la Recherche Agronomique en Tunisie (INRAT) Tunis, TUNISIA
	Upper Volta	Monsieur le Directeur de l'IRAT/Haute Volta	Boite Postale 596 Ougadougou REPUBLIQUE VOLTAIQUE
		Mr. M. Dhery	Le Directeur IRHO/HV Secteur Haute-Volta B. P. 21 Koudougou UPPER VOLTA
	Zambia	Mr. A. J. Prior	Mount Makulu Research Station P.O. Box 7 Chilanga, ZAMBIA
		Dr. M. A. Taha	Dean, School of Agricultural Science University of Zambia P.O. Box 2379 Lusaka, ZAMBIA

Region	Country	Name	Address
ASIA	Afghanistan	Mr. Mohammad Arif Noori	President of Research Research Division Ministry of Agriculture and Irrigation Kabul, AFGHANISTAN
		Dr. M. N. Aslamy	Faculty of Agriculture Kabul University Kabul, AFGHANISTAN
	Bangladesh	Dr. Peter R. Hobbs	Associate Agronomist The Ford Foundation P.O. Box 98, Ramna Dacca - 2, BANGLADESH
	Bhutan	Dr. M. S. Lal	Economic Botanist Directorate of Agriculture Thimphu, BHUTAN
	India	Dr. C. B. Singh	Botanist (Soybean) Department of Plant Breeding and Genetics J. N. Krishi Vishwavidhyalaya Jabalpur - 4(M.P.), INDIA
		Dr. B. B. Singh	Department of Plant Breeding G. B. Pant University of Agriculture and Technology Pantnagar, Nainital U. P., INDIA
	Indonesia	Dr. Russell D. Freed	IRRI JL. Merdeka 99 P.O. Box No. 107 Bogor, INDONESIA
		Ir. Soenjoto Djojodiridjo	Department of Agronomy University of Gadjah Mada Jogjakarta, INDONESIA
		Ir. A. Djamhuri M.	Director-Experimental Farm Kebun Jeruk Tebing Tinggi-Deli Sumatra-Utara, INDONESIA
	Malaysia	Mr. Mohamed Shah bin Kadir	Managing Director Soya Industries P.O. Box Pudu 6035 Kuala Lumpur, MALAYSIA
	Nepal	Mrs. Meena Panday	Department of Agriculture Agriculture Botany Section Khumalta, Lalilpur, NEPAL

Region	Country	Name	Address
ASIA	Pakistan	Mr. J. R. Lockman	TSA Agricultural Project 23-2 Race Course Road Lahore 3-PAKISTAN
		Mr. Samahad Akhtar Khan	Oilseed Botanist Punjab Agricultural Research Institute Lyallpur, PAKISTAN
		Mr. S. Sayed Badshah	Economic Botanist Agricultural Research Institute Tarnab, Peshawar, PAKISTAN
	Philippines	Mr. Benjamin M. Legaspi	In-Charge, Legume Research Project Department of Agriculture & Natural Resources Bureau of Plant Industry Economic Garden, Los Banos, Laguna, PHILIPPINES
		Dr. Ricardo M. Lantican	Professor, Department of Agronom U.P. College of Agriculture U.P. at Los Banos, College Laguna E-109, PHILIPPINES
	South Korea	Dr. John M. Yohe	Office of Rural Development Crop Experiment Station Suweon, REPUBLIC OF SOUTH KOREA
	Sri Lanka	Mr. Eddie Herath	Central Agricultural Res. Institute Gannoruwa Peradeniya SRI LANKA (CEYLON)
	Taiwan	Mr. S. Shanmugasundaram	Research Associate (Breeding) The Asian Vegetable Research and Development Center P.O. Box 42, Shanhua, Tainan, 74 TAIWAN, REPUBLIC OF CHINA
	Thailand	Dr. Arwooth NaLampang	Department of Agriculture Leader of Oil Crop Project Ministry of Agriculture Bangkhen, Bangkok 9 THAILAND
		Dr. Prasan Yingchol	Soybean Research Project Supervisor Division of Agronomy Department of Plant Science College of Agriculture Kasetsart University Bangkok, THAILAND

Region	Country	Name	Address
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		Mr. Rangsan Keereetaveep	Mae-Jo Agricultural Experiment Station Chiang Mai, THAILAND
		Mr. Apinan Kamnabut	Agronomy Department Kasetsart University Bangkok, THAILAND
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Region	Country	Name	Address
EUROPE	Yugoslavia	Dr. R. Savic, Head	Maize Department Institute of Agricultural Research Novi Sad, YUGOSLAVIA
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		Ing. Agron. Maritza de Sanchez	Asistente Tecnico Div. Leguminosas de Grano Subsecretaria de Estado de Investigaciones Extension y Capacitacion Agropecuarias San Cristobal, DOMINICAN REPUBLI
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SOUTH AMERICA	Argentina	Ing. Agr. Jose B. Goldenberg	Coordinator, Unidad Ecogenetica Ministerio de Agricultura y Ganaderia Instituto Nacional de Technologi. Agropecuaria Centro de Investigaciones en Ciencias Agronomicas C.C. 25 Castelar - REPUBLICA ARGENTINA
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	Brazil	Mr. Fazal Rahman	Researcher Scientist Instituto Nacional de Pesquisas da Amazonia Caixa Postal 478 Manaus, Amazonas BRAZIL
	Chile	Mr. Hugo Geldres R.	Instituto de Investigaciones Agropecuarias Estacion Experimental La Platina Santa Rosa 11610 - Paradero 33 Casilla 10 La Granja Santiago, CHILE
	Colombia	Ing. Gilberto Bastidas R.	Director of Nacional Programa Leguminosas de Grano y Oleaginosas Anuales I.C.A. Palmira, COLOMBIA

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	Guiana	Monsieur le Chef de la Mission	IRAT/Guyane Boite Postale 60 97301 Cayenne, FRENCH GUIANA
	Guyana	Mr.Herman Adams	Agricultural Officer (Soybeans) Ministry of National Development & Agriculture Central Agricultural Station Mon Repos, East Coast, Demerara GUYANA
	Peru	Ing. Rufino Montalvo Sosa	Estacion Experimental Agraria de La Molina La Molina, PERU
		Ing. Franco Caballero	Estacion Experimental del Chira Sullana, PERU
		Ing. Cesar A. Moyano S.	Sub-Estacion Experimental de Huarangopampa Bagua, PERU
		Ing. Angel Gastelo N.	Estacion Experimental Agraria de Vista Florida Apartado 116 Chiclayo, PERU
	Uruguay	Mr. E. Reynaert	Casilla de Correo1207 Montevideo, URUGUAY
	Venezuela	Ing. Agr. Simon Ortega	Mejoramiento Genetico de Leguminosas Apdo. 4653 - Maracay 200 VENEZUELA
NEAR EAST	Iran	Dr. M. C. Amirshahi	Vice Dean Karadj Agricultural College University of Teheran IRAN
		Dr. Luis H. Camacho	UNDP Building 12 Kh. Bandar Pahlavi Off Takhte Jamshid Teheran, IRAN

Region	Country	Name	Address
NEAR EAST	Iran	Dr. J. C. Carapetian	College of Agriculture and Animal Husbandry P.O. Box 32 Rezaiyeh, IRAN
	Iraq	Dr. Gursham S. Grewal	FAO Mission to Iraq P.O. Box 2048 Alwiyah, IRAQ
	Israel	Dr. Baruch Retig	Agricultural Research Organizatic The Volcani Center P.O.B. 6 Bet Dagan, ISRAEL
	Jordan	Mr. Akram Turk	Director, Agriculture Research Centre Wadi Dhuleil Centre, JORDAN
	Lebanon	Dr. S. Abu Shakra	Chairman Dept. of Crop Prod. & Prot. American University of Beirut Beirut, REPUBLIC OF LEBANON
	Saudi Arabia	Mohamed Ali Makki	Director General of Agricultural Development Ministry of Agriculture and Water Riyadh, SAUDI ARABIA
		Mr. W. L. Chang	Leader, Chinese Rice Mission Animal Production & Agriculture Research Center P.O. Box 143 Hofuf, SAUDI ARABIA
	Syria	Dr. Mohamed Ibrik	Syrian Arab Republic Ministry of Agriculture and Agrarian Reform Damascus, SYRIA
OCEANIA	British Solomon Islands	The Permanent Secretary	Ministry of Agriculture & Rural Economy Agriculture Division P.O. Box 25 Honiara, BRITISH SOLOMON ISLANDS
	Fiji	The Assistant Director (Research)	Ministry of Agriculture, Fisheries and Forests Suva, FIJI
	French Polynesia	Monsieur le Chef du Service de l'Economie Rurale	B.P. 100 Papeete, Tahiti FRENCH POLYNESIA

Region	Country	Name	Address
OCEANIA	New Caledonia	Mr. Michel Lambert	Tropical Agriculturalist South Pacific Commission Post Box D. 5 Noumea Cedex NEW CALEDONIA
		Monsieur le Chef du Service de l'Agriculture	B. P. 43 Noumea, New Caledonia
	New Hebrides	Monsieur le Chef du Service de l'Agriculture	Port Vila, NEW HEBRIDES

Appendix C

INTSOY
Department of Agronomy
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Urbana, Illinois 61801 U.S.A.

Instructions for the Management of the

Soybean Seed Quality Trial (Year 1)

Variable soybean seed quality frequently necessitates the use of excessive seeding rates to compensate for poor emergence. In tropical regions, where yield of early maturing cultivars is particularly dependent on establishment of adequate plant stands, seed quality problems may limit the commerical use of such varieties.

The Soybean Seed Quality Trial was organized by INTSOY as one of several multidisciplinary efforts to improve overall soybean seed quality. Its basic objectives are to 1) monitor seed quality of introduced, early maturing cultivars in different tropical environments, 2) determine the effects of variations in seed quality on stand establishment and productivity of the subsequent soybean crop and 3) evaluate the usefulness of a foliar applied fungicide in improving soybean seed quality in the tropics.

The following instructions are for the first year of the study which includes only 24 field plots. In subsequent years, productivity of locally produced seed will be compared with that of freshly imported seed produced at Urbana, Illinois. Trial size in the second and subsequent years will be 72 field plots.

Plan of the Experiment (Year 1)

The experiment includes 3 cultivars (Clark 63, Williams and Beeson) and 2 levels of foliar fungicide (applied or not applied). Each treatment combination is replicated 4 times in a randomized block design. The plots contain 4 rows and the seed is individually packaged for each row. The entry name and plot number are printed on each packet. In the seed shipment provided, the packets have been arranged and are to be planted according to plot number. Plots with 1 as the first number are in replicate I, when 2 is the first number they are in replicate II, and so forth for replicates III and IV. For example, plots 101 to 114 are in replicate I, plots 201 and 214 are in replicate II, plots 301 to 314 are in replicate III, and plots 401 to 414 are in replicate IV. Plot numbers are three digit numbers found in the upper portion of the seed packet.

The seed contained in each packet have been counted and should be uniformly distributed in a 6 meter row. Rows should be spaced 60 cm apart.

A map of the experiment is attached. Each replication contains 6 plots. Paths between replicates and around the experiment are included to facilitate easy access for application of treatments and for taking notes. Two guard rows should encircle the entire experiment; additional packets of seed are provided for this purpose.

Land Preparation and Fertilization

Land preparation should be adequate to provide a favorable seed bed for the soybeans. All clods should be broken. A sufficient quantity of fertilizer should be applied so that nutrient deficiences do not limit growth and development of the crop. To insure that minimal requirements are met, it is suggested that at least 60 kg P_2O_5 and 30 kg K_2O per hectare be uniformly applied. These fertilizers should be broadcast and incorporated during preparatory tillage before planting.

The soil pH level should be between 6 and 7 for optimum soybean development. If pH is below 6, agricultural limestone should be applied to raise the pH to this level.

Soil Inoculation

In place of nitrogen fertilizer, soybeans should be treated with the proper Rhizobium bacteria. Granular inoculant was included with the seed shipment. The inoculant should be stored under refrigeration until used. The inoculant should be evenly distributed at the rate of 5 grams per 6 meter row in the trench immediately before the seed is planted. Cover the trench with soil immediately after planting the seed to prevent death of the bacteria.

Thinning

Because the objectives of this experiment include the comparison of performance of seed lots having different levels of viability and vigor, plant stand should be uniform in all treatments. Fourteen days after the initiation of emergence, count the total number of plants in the two center rows of each plot. After recording this value, the stand in each row should be thinned to 24 plants per meter of row (144 plants in each row). No selection for plant vigor should be practiced during the thinning operation.

Application of Fungicide Treatment

A mixture of Benlate and Captan is provided for two applications to designated plots. The rate of application is 4 kg per hectare. The appropriate quantity for each plot (0.4 gm fungicide/m^2 = 5.76 gm fungicide/plot) should be applied in 1 liter of water. To facilitiate mixing in the field, the correct quantity of fungicide for one application to 12 plots (69.12 gm) is provided in a sealed vial. Even though 12 liters of spray are prepared in a single operation, only enough for one plot (1 liter) should be put in the sprayer at one time.

Two applications are necessary. The first application should be made at early pod set (when the majority of the plants have a pod 0.5 cm long at one of the four uppermost nodes); the second application should be made 18-20 days later.

Application of the fungicide should be made on a calm day. Even on a calm day, however, it is advisable to place a portable "curtain" of vinyl around the plot being sprayed to insure that adjacent plots are not containinated. The "curtain' can be supported by four persons, as depicted on the next page, and moved from plot-to plot.

(Twelve additional pages of detailed instructions are being sent to all cooperators.)

Appendix D

Some References on Use of Whole Soybeans for Food

1. "FOOD PRODUCTS FROM WHOLE SOYBEANS"

   *A. I. Nelson, L. S. Wei, and M. P. Steinberg.

   Soybean Digest, January 1971.

2. "CANNED PORK AND SOYBEANS: A NUTRITIOUS AND TASTY NEW PRODUCT"

   *L. S. Wei, Ruben Berra, A. I. Nelson and M. P. Steinberg.

   Illinois Research, University of Illinois Agricultural Experiment Station, 15(2), (1973).

3. "SOYBEAN DAMAGE DETECTION AND EVALUATION FOR FOOD USE"

   E. D. Rodda, *M. P. Steinberg, L. S. Wei.

   Transactions of the ASAE 16(2); 365-366, (1973).

   A mechanical sorting system in combination with a soaking operation has been demonstrated to be an effective method of removing damaged soybeans prior to food processing operations. The method appears suitable for scaling up to production quantities. Germination tests indicate a possible application for the procedure in the seed industry.

4. "A SIMPLE SHEAR PRESS FOR MEASURING TENDERNESS OF WHOLE SOYBEANS"

   James Spata, * M. P. Steinberg and L. S. Wei.

   J. Food Science, 38; 722-723, (1973).

5. "NUTRITIONAL AND CHEMICAL STUDIES OF THREE PROCESSED SOYBEAN FOODS"

   M. Shemer, * L. S. Wei and E. G. Perkins.

   J. Food Science, 38; 112-115, (1973).

   Some nutritional and chemical properties of 3 processed whole soybean foods were examined. Drum dried whole soy flake had an NSI = 15% & PER = 2.1. Canned whole soybeans had an NSI = 24 and PER = 1.4. A drum dried soy:banana (1:1) flake had an NSI = 6.3 and PER = 1.4. Added methionine improved the PER's.

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6. "FOODS FROM WHOLE SOYBEANS"

*A. I. Nelson and L. K. Ferrier.

Presented at the Workshop on Soybeans for Tropical and Subtropical Conditions, 4-6 February 1974, Mayaguez, Puerto Rico. INTSOY Publication Series-Number 2, May 1974.

Soybeans are an excellent source of nutrients. Dry soybeans have about 40% protein and 20% oil. The amino acid content is close to the optimum recommended by the FAO and the oil has a considerable amount of unsaturated amino acids. It is also a good source of some vitamins and minerals.

Some of the whole soybean food products prepared at the University of Illinois are: soybean flakes or soy-cereal flakes, canned soybeans, soybean beverages and derived products, spreads and snacks.

7. "DEVELOPING A SOYABEAN DAL FOR INDIA AND OTHER COUNTRIES"

Dr. James A. Spata, *Prof. A. I. Nelson and Dr. S. Singh.

World Crops, March/April, 1974.

Soybeans were precooked, dried, dehulled and cracked to make a soybean dal. The soybean dal cooking characteristics, organoleptic acceptability and cost were in the same range as those for dals in commercial use in the area (Pant Nagar, Uttar Pradesh).

8. "SIMPLE PROCESSING OF WHOLE SOYBEANS"

*Dr. Les K. Ferrier.

From "SOYBEAN PRODUCTION, PROTECTION, AND UTILIZATION" Proceedings of a Conference for Scientists of Africa, the Middle East, and South Asia, October 14-17, 1974, Addis Ababa, Ethiopia. INTSOY Series Number 6; 178-188, March, 1975.

9. "WEANING FOOD PREPARED FROM WHOLE SOYBEANS AND BANANAS BY DRUM DRYING"

*Ferrier, L. K., Bird, D., Wei, L. S. and Nelson, A. I.

Arch. Latinoamer, Nutr., Special Edition, 1975. pp. 281-295.

Good tasting, high protein weaning foods were prepared by drum drying soybean-banana slurries. The typical "beany" or "painty" flavor of soybeans was completely prevented by water blanching the whole soybean. The blanched beans were finely ground and blended with the bananas before drying. Optimum ratios of soybean: banana were 1:1 and 3:2 on a solids basis. Most desirable flavor, color and storage stability was obtained when fully ripe bananas having at least 24% soluble solids were used. Addition of $NaHSO_3$ improved the color and flavor stability during storage. The weaning food had very good stability in storage for 13 months at 38°C under vacuum and at 21°C in air. The 1:1 soybean:banana mixture contained 23% protein, 8.8% oil and 50% carbohydrates and when rats were allowed free access to the weaning food they appeared to have normal growth. It is suggested that soybean:banana flakes would be acceptable as high protein weaning foods with little or no modification to suit local preferences.

10. "A NEW ILLINOIS SOYBEAN BEVERAGE: TASTY, SMOOTH, NUTRITIOUS, AND ECONOMICAL"

*L. S. Wei, M. P. Steinberg, and A. I. Nelson.

Illinois Research, Fall, 1975. 17(4); 3-4.

11. "ILLINOIS PROCESS FOR PREPARATION OF SOYMILK"

*A. I. Nelson, M. P. Steinberg and L. S. Wei.

J. of Food Science, 41(1); 57-61, (1976).

A beverage consisting of water, whole soybeans (including hulls), sugar and flavor has been developed. Preparation includes soaking and then blanching the whole soybeans in 0.5% sodium bicarbonate, grinding with water in a hammermill, heating the slurry to 200°F, homogenizing, neutralizing, dilution, addition of sugar and flavor, pasteurizing and re-homogenizing. Enzyme inactivation by blanching prior to grinding of soaked beans was found to completely prevent formation of painty (oxidized) flavor and result in a bland flavored product. Trypsin inhibitors were also inactivated by blanching. A sufficient degree of tenderization of soybean tissue during the soak and blanch treatments was necessary to obtain good mouth feel and colloidal stability. Homogenizing conditions such as temperature and pressure were also important; when the soybeans had been blanched to a LEE-Kramer Tenderometer reading of 300 lb or below and homogenization was done at 200°F and 3500 psi, the resulting beverage showed zero separation after 2 months refrigerated storage. Dilution to below 1% protein had no effect on colloidal stability. Coulter Counter measurements of the beverage indicated that 81% of the particles fell between 3.4-7.3 microns which is larger than the defined colloidal particle range. Recoveries of protein and total solids based on the raw soybean were 99% and 90%,respectively.

12. "EXTRACTION OF OLIGOSACCHARIDES DURING COOKING OF WHOLE SOYBEANS"

Shun Ku, *L. S. Wei, M. P. Steinberg, A. I. Nelson and T. Hymowitz.

J. Food Science, 41(2); 361-364, (1976).

Raffinose and stachyose present in soybeans have been reported to cause flatulence. The objective of this work was to study the aqueous extraction of whole soybeans during water cooking to determine optimum conditions for maximum removal of oligosaccharides with minimum loss of protein. Chief variables were bean to water ratio (1:3, 1:5, 1:7.5 and 1:10) and pH. Residual oligosaccharides in the soybeans were determined by silylation followed by GLC analysis. During 20 min.boiling in water, a 1:10 ratio resulted in 33% oligosaccharide extraction (g per 100g original oligosaccharide) with 1% protein loss (g per 100g original protein) while a 1:3 ratio gave only 7.7% oligosaccharide removal with 0.9% protein loss. When the time was extended to 60 min, a 1:10 ratio resulted in 59% extraction with 2.6% protein loss and 12% total solids loss (g per 100g original soybean solids). With the latter treatment, sucrose fell from 6.5 to 3.0% dry basis and fructose fell from 1.6% to 1.0%. Addition of 0.5% $NaHCO_3$ to the tap water (initial pH 8.1) increased oligosaccharide removal but trebled protein loss to 6.8% while addition of HCl to initial pH 4.3 gave about the same protein loss and oligosaccharide removal as tap water.