PD-AAV-161
49068

Development of Improved Varieties of Soybeans Supporting Cultural and Marketing Practices for Production in the Tropics and Information Delivery Systems

January 1, 1982 - December 31, 1982

IPR-83-1

Development of Improved Varieties of Soybeans Supporting Cultural and Marketing Practices for Production in the Tropics and Information Delivery Systems

Annual Report of
Contract AID/TA-C-1294
January 1, 1982 - December 31, 1982

Submitted to
The U.S. Agency for International Development
Department of State
Washington, D.C.

by
The University of Illinois at Urbana-Champaign
College of Agriculture
International Soybean Program, INTSOY
IPR-83-1

TABLE OF CONTENTS

Summary 1

Statistical Summary 1

Narrative Summary 2

Report of Progress 5

Goals 5

Approval. 5

Objectives. 5

Research Results. 5

Development of Improved Genetic Material. 6

Improved *Rhizobium japonicum* Technology for the Tropics . . . 19

Improved Disease and Insect Control 27

Improved Soybean Insect Management Systems. 48

Seedborne Pathogens and Factors Influencing Them. 53

Auxiliary Activities 58

Soybean Insect Research Information Center (SIRIC). 58

INTSOY Newsletter and Mailing List. 61

INTSOY Publication Series 61

Training Activities 65

Conference and Travel Activities. 66

Administration and Budget 67

Appendix 1: ISVEX 1982 Cooperators/Organizations 68

Appendix 2: Summary of SIRIC Services, 1982. 76

Appendix 3: SIRIC Questionaire 81

Appendix 4: INTSOY Staff Publications. 82

INTSOY Project Staff. 88

SUMMARY

STATISTICAL SUMMARY

1. Project Title and Contract Number: Development of Improved Varieties of Soybeans Supporting Cultural and Marketing Practices for Production in the Tropics and Information Delivery Systems--AID/TA-C-1294.

2. Principal Investigator, Contractor, and mailing address:

   Harold E. Kauffman, Director
   International Soybean Program, INTSOY
   College of Agriculture
   University of Illinois at Urbana-Champaign
   113 Mumford Hall
   1301 West Gregory Drive
   Urbana, Illinois 61801

3. Contract Period: April 1, 1976-June 30, 1984

4. Period Covered by Report: January 1, 1982-December 31, 1982

5. Total AID Funding of Contract to December 31, 1982: $5,105,855

6. Total Expenditures for Report Period: $969,876

NARRATIVE SUMMARY

During 1982 INTSOY staff continued to carry on research activities at the University of Illinois and the University of Puerto Rico headquarters as well as collaboratively with soybean scientists at several international agriculture research centers and a number of national programs. INTSOY scientists increased their contacts with soybean scientists at the International Institute of Tropical Agriculture (IITA), Nigeria, and the Asian Vegetable Research and Development Center (AVRDC), Taiwan, to improve coordination of activities in Africa and Asia. Contacts with many national program scientists were also increased.

Improved Genetic Materials. The international soybean cultivar trials continued to be the most visible and largest collaborative research activity. Approximately 150 scientists from 130 research organizations in 82 countries cooperated in evaluating the three types of INTSOY trials: SIEVE, SPOT, and ISVEX. The 30 new cultivars in the 1982 SIEVE were nominated by 18 breeders from 9 countries. An increased percentage of the entries were from tropical and subtropical countries. Of the 195 ISVEX test sites, 104 were in the tropics, 42 in the subtropics, and 49 in the temperate zone. Results of the trials continue to show potential for soybeans in a wide range of tropical and subtropical environments. Yield performance of several cultivars in the 1981 SIEVE from programs in tropical and subtropical countries reflects the growing strength of such programs. Rosales-S-80, from Mexico, and Florida, from Brazil, yielded considerably higher than the standard U.S. check varieties. The trials identified cultivars which can be used directly for production in some countries and as parents in accelerated cultivar improvement programs in other countries.

The INTSOY hybridization program in Puerto Rico continues to focus on three main objectives: 1) to combine high yield potential with tropical and subtropical adaptation and improved canopy; 2) to develop insect resistant lines with proper maturity and plant type for lower latitudes; and 3) to develop lines with extended seed storability under ambient conditions. The range of genetic variability of parents used and the number of crosses made continued to increase, resulting in widely diverse genetic materials. Some early generation breeding lines were sent to several South and Central American countries to be evaluated in a wide range of environments. A special collaborative effort was undertaken by IITA and INTSOY to evaluate and identify cultivars exhibiting longevity in storage.

A set of 20 soybean mosaic virus (SMV) resistant lines were evaluated for yield potential in Puerto Rico as well as Pakistan and AVRDC. In Puerto Rico several lines were nearly equal in yield performance to those of Improved Pelican and Jupiter.

Improved *Rhizobium japonicum* Technology. Significant interaction between cultivars and organism continued to be demonstrated in long term studies on the population and distribution of *Rhizobium japonicum*. The longevity studies of *R. japonicum* on acid, high-aluminum corozal

soil continued to show differential affects on population of the bacterium and yields of soybean cultivars. Additional evaluation and serology testing of the nodules are underway. Studies on the influence of *Azotobacter* strains on *Rhizobium japonicum* showed that strain USDA 123 was significantly stimulated by *Azotobacter beijerinckii* and *Azotobacter chroococcum*. However, growth of strain TAL 184 was depressed in the presence of both *Azotobacter* species.

The search for improved inoculant carriers showed vermiculite to be a promising inoculant carrier. Larger vermiculite particles were able to support a higher population of introduced *Rhizobium* than small ones. Efforts to control moisture loss from granular peat by applying mineral oil and glycerol gave inconsistent results. The effort to develop liquid inoculants under non-laboratory conditions by sterilization with gamma radiation, propylene oxide, chlorox, or alcohol was not successful.

The evaluation of *Rhizobium* isolates from several countries continued. A study of isolates from nodules collected from soybeans in Vietnam indicated that 14 were traditional slow growing types while the remaining 24 were fast growing isolates. The majority of the fast growing isolates were obtained from nodules collected from ISVEX trials where Nitragin® was applied. Isolates collected from India are currently being evaluated.

Improved Insect and Disease Control. Studies on the effect of soybean mosaic virus (SMV) infection on plant growth related parameters indicate that the mild isolates reduce yields by approximately 20% and severe isolates by approximately 70%. Yield loss was attributed to a reduced number of seeds per pod, greater number of unfilled pods, and the reduced size of seed. The total number of pods per plant was not affected. A relationship was noted between initial infection rate and seed coat mottling, but no correlation was seen between the level of infection and seed germination or seed weights. The seed transmission rate of SMV varies depending on variety and strain.

The collection in China of thirty samples of soybean plants with virus-like symptoms resulted in the identification of 21 isolates; 16 as soybean mosaic virus, one as tobacco ring spot virus (TRSV), and one as southern bean mosaic virus (SBMV). Three had double infections of SMV and SBMV. Several of the virus strains isolated from Chinese material infected cultivars that had been resistant to all previously known strains of SMV.

Research was initiated on machismo disease by collecting plants with machismo-like symptoms in Colombia and Mexico. Preliminary tissue sectioning for Deines' staining gave positive results indicating a mycoplasma-like causal organism. Sections of tissue have been fixed for examination by electron microscopy.

Significant progress was made in the development of sensitive detection methods for whitefly-borne geminiviruses. These detection methods have shown that geminiviruses related to bean golden mosaic viruses cause several whitefly transmissable yellow mosaic diseases in Puerto Rico. Several of these occur on soybeans.

Entomology research and technology transfer activities have led to the development of (a) sampling methodologies for aphids as vectors of plant viruses and for important pest predators in the soybean ecosystem, (b) soybean mosaic virus epidemiology and associated virus-vector soybean relationships, and (c) the development and implementation of an insect pest management program for soybean in the high jungle zones of Peru. The sampling method, using the INTSOY designed aphid traps, was tested in regional trials in Georgia, Louisiana, Mississippi, Virginia, and Illinois. Successful results indicate that the next step is to test the spread of aphids in soybeans on an international basis. The INTSOY sampling methodology is already being used on several crops within the United States and in several countries in the developing world to monitor aphid vector movement.

Substantial progress has been made towards determining the effects of major cultural practices on the behavior and abundance of aphid vectors of soybean mosaic virus and predator and parasitoid orientation and abundance in soybean and associated crop ecosystems. Aphid behavior has been linked to virus incidence spread and this, in turn, to soybean yield and seed parameters.

Insect Pest Management Systems. The soybean insect pest management program in the high jungle zones of Peru has now been expanded to include the northern coastal zones of Peru. Moreover, AID/Peru is interested in expanding the concepts developed for the program into a national program in pest management involving five basic food commodities and all protection disciplines.

Seedborne Pathogens. Research on diseased seeds continued to identify and determine the role organisms play in adversely affecting seed quality. Significant varietal variation was found in the incidence of infection by *Phomopsis* spp., *Cercospora* spp., *Alternaria* spp., and *Cladosporium* spp. and resulting influence on seed quality.

Cercospora sojina, the causal organism of frogeye leafspot, was shown to be highly variable in pathogenicity. Seven new races were identified. Web blight caused by *Rhizoctonia solani* was reported for the first time in Puerto Rico.

Research continued on factors which influence seedborne pathogens such as desiccants, insects, and tillage practices. Studies on the effect of three desiccant herbicides (paraquat, glyphosate, and sodium chlorate:sodium borate), on several seedborne pathogens of soybeans showed that rainfall and temperatures at seed maturation were more important variables in pod-to-seed infection by several fungi than increased rates of tissue senescence caused by the dessicants. Unusually high beetle populations (*Cerotoma trifurcata*) were, however, shown to be associated with high occurrence of seedborne fungi in several experiments. Among five tillage practices studied those with high population densities consistently resulted in more seed disease and lower seed weight.

Several treatments to reduce seed fungi were attempted. Treatment of seed with hot refined soybean oil was shown to reduce seedborne fungi, particularly *Phomopsis* spp.

REPORT OF PROGRESS

GOALS

The goals of the project are to increase production of soybeans by small-scale farmers in tropical and subtropical LDCs and to increase utilization of soybeans for food use by rural and urban poor.

APPROACH

Work on this project features the multidisciplinary, interinstitutional approach that has been used successfully in the INTSOY program. The project sustains and improves research output and competence in selected areas, and contributes to the generation of knowledge to be shared with soybean scientists worldwide. The primary focus is the identification of constraints affecting soybean production, protection, and use in tropical and subtropical LDCs, development of research activities to overcome these constraints in LDCs, and the dissemination of information to LDC and international institutions. Special emphasis is given to adaptive research to speed the benefits of research to small-scale farmers and agricultural institutions of tropical LDCs.

OBJECTIVES

Five major objectives, or outputs, are included in the most recent "Statement of Work" covering the period July 16, 1980-November 30, 1982. They are:

1. Develop improved genetic materials for use in LDC research and production programs and improved linkages among soybean breeders.
2. Develop improved technology for *Rhizobium japonicum* production and management under tropical conditions.
3. Improve the knowledge base for disease, insect, and weed control in soybeans produced under tropical environments.
4. Develop soybean disease, insect, and weed management systems for tropical and subtropical areas.
5. Develop improved production, harvesting, handling, and storage methods for seed and grain under tropical conditions.

Objective 4 activities concentrated on development of insect pest management systems while little was done in weed management. Objective 5 activities focused on seed pathogen problems.

RESEARCH RESULTS

INTSOY's interdisciplinary approach has characterized the steady growth and development of the program and is evident in the following summary reports. Individual researchers have cooperated in addressing problems associated with interrelated objectives in a manner that maximizes the limited personnel, facilities, and budget resources available to the project.

DEVELOPMENT OF IMPROVED GENETIC MATERIALS

The INTSOY soybean cultivar improvement program continues to focus on two complimentary operations. Cultivar screening and breeding work is conducted at the Isabela Sub-Experiment Station in Puerto Rico in cooperation with the University of Puerto Rico, Mayaguez Campus, and the Agricultural Experiment Station at Isabela. Cultivar evaluation work is accomplished through a series of international cultivar trials in cooperation with soybean workers in approximately 85 countries. These trials are coordinated in the Department of Agronomy at the University of Illinois at Urbana-Champaign, with seed increase for the tropically adapted varieties done in Puerto Rico.

The soybean research work conducted at Isabela during the reporting period was concerned with cultivar testing, development and testing of breeding lines, and hybridization of plant materials for the development of improved germplasm for tropical environments.

Cultivar Testing. The genetic improvement program is directed to the identification, evaluation, and distribution of improved soybean germplasm with particular attention to the development of cultivars demonstrating adaptation to tropical and subtropical environments. Such cultivars must exhibit high, stable yields, satisfactory photoperiod responses, broad ecological adaptability, and resistance or tolerance to disease pathogens, insect pests, and problem soils. Scientists affiliated with international, national, and private research organizations utilize this advanced soybean germplasm for their research or cultivar production programs.

INTSOY has the following 3 main research trials: the Soybean Initial Evaluation Variety Experiment (SIEVE), the Soybean Preliminary Observation Trials (SPOT), and the International Soybean Variety Evaluation Experiment (ISVEX). The methodology involved and the research objectives inherent to SIEVE, SPOT, and ISVEX have been detailed in the 1981 INTSOY Project Report (IPR-81-1), "Development of Improved Varieties of Soybeans Supporting Cultural and Marketing Practices for Production in the Tropics and Information Delivery Systems," April 1, 1980-December 31, 1981.

SIEVE. The summary of the 1981 SIEVE is presented in Appendix 1. Noteworthy are the levels of performance achieved by international cultivars in comparison to the standard check cultivars Bossier and Davis. Rosales-S-80, from Mexico, yielded 3,663 kg/ha, matured in 91 days, and was stable in all characteristics. Davis yielded 2,743 kg/ha, was shorter in stature and matured in 89 days. Florida, a cultivar from Brazil, was taller than Davis, yielded 3,182 kg/ha, and matured in 92 days. Bossier was ranked 11th and Davis was ranked 19th in the 1981 SIEVE results when compared to 32 cultivars contributed by 13 breeders from 12 countries.

The excellent performance of international cultivars can be attributed to the expansion of breeding and cultivar development programs in the tropics and subtropics. Since SIEVE's inception in 1978, 177 cultivars have been evaluated, of which 92 were advanced to SPOT. Thirty-four cultivars were selected from SPOT and entered in ISVEX. A total of 55 breeders from 24 countries have contributed cultivars to this program.

SIEVE 1982 is being conducted by collaborating scientists in Colombia, Sri Lanka, Puerto Rico, Texas (U.S.A.), and the Philippines. The Philippines received the germplasm for planting in February 1983. The advanced germplasm for this research was nominated and contributed to INTSOY by 18 plant breeders from nine countries. These breeders selected and entered 30 of their improved soybean lines for initial screening and evaluation. Cultivars with good agronomic performances were advanced to the Soybean Preliminary Observation Trials (SPOT). A summary of SIEVE composition from 1978 to 1982 is given in Table 1.

Table 1. SIEVE Composition From 1978 to 1982

	1978		1979		1980		1981		1982		
Item	Per year	New	Per year	New	Per year	New	Per year	New	Per year	New	Total
Germplasm contributors	26	(26)	16	10	11	4	13	2	12	8	78 (50)
Cultivars evaluated	50		30		26		30		30		166
Originating countries	15	(15)	9	3	9	1	10	1	9	1	52 (21)

SPOT. A preliminary summary has been prepared on the 1981 SPOT. Of the 24 cultivars destined for tropical and subtropical sites, 17 cultivars were of international origin. The remainder are recent U.S. releases and standard check cultivars. The 10 most promising cultivars were promoted to the 1983 ISVEX.

The 1982 SPOT is currently being conducted at 20 environmentally different sites in 16 countries. There are 16 entries in SPOT 82, of which 13 were selected from SIEVE. Ten breeders from 7 countries are responsible for development of these cultivars.

Cultivars entered in SPOT exhibit a wide range of maturities. Huites 77, an entry from Mexico, matures in 97 days in Puerto Rico and Baru, a Panamanian entry, matures in 130 days in Puerto Rico. A cultivar's maturity classification denotes its response to photoperiod and is, in part, a measure of its suitability for tropical and subtropical climates. Cultivars are selected for ISVEX on the basis of maturity ratings in combination with days to flowering rates and yield performances. An assessment of days to maturity is utilized for designating a cultivar's placement in the ISVEX trials.

ISVEX. Large scale evaluation and cultivar distribution are accomplished through the ISVEX program. Eighty-two countries participated in the 1981 ISVEX, which included over 130 different research organizations. Research trials were distributed for planting at 195 sites, of which 104 were situated in the tropics, 42 in the subtropics, and 49 in the temperate zone. A guide for determining ISVEX zones and groups of varieties is shown in Table 2.

Table 2. ISVEX Zones and Groups

Altitude	Latitude 0-10° Zone	0-10° Group[a]	10-20° Zone	10-20° Group	20-30° Zone	20-30° Group	30-40° Zone	30-40° Group
0-500 m	I	A	IV	B	VII	B	X	B
500-1,000 m	II	A	V	B	VIII	B	XI	C
1,000-2,000 m	III	B	VI	B	IX	B	XII	C
2,000 m	XII	C	XII	C	XII	C	XII	C

[a]Tropical Group A cultivars includes cultivars of maturity group classification VI through X or greater. Subtropical Group B cultivars includes cultivars of maturity group classification IV through VII. Temperate Group C cultivars includes cultivars of maturity group classification 00 through V.

The ISVEX 1982 has been distributed to approximately 80 countries: 97 tropical research trials (Group A), 39 subtropical trials (Group B), and 44 temperate trials (Group C).

Ten cultivars of the 1982 ISVEX entries originated from earlier SIEVE's. Eighteen tropical and subtropical cultivars were entered out of a total of 28 cultivars. A summary of the ISVEX composition from 1973 through 1982 is given in Table 3.

Table 3. ISVEX Composition From 1973 to 1982

Item	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Trials	90	136	259	292	179	177	151	166	183	179
Countries	33	69	90	84	48	86	63	67	82	85
New countries[a]	33	20	23	13	8	10	6	2	--	1
Cooperators	49	68	106	105	94	118	101	110	155	124
Cultivars	20	15	25	26	28	36	38	47	38	39
New Cultivars	--	3	13	6	4	18	2	26	5	--

[a]Total of 118 countries have evaluated ISVEX.

ISVEX 1981 results are currently being analyzed. Individual combined analyses have been returned to the cooperating scientists.

Earlier INTSOY cultivar trial research has produced a basic understanding of the soybean's nature. Since soybeans originated and have been grown primarily in temperate regions, there is a question as to how well existing cultivars are adapted to tropical and subtropical environments. ISVEX results have provided the following information: Average yields of check cultivars were the same in the tropics (1,885 kg/ha) and subtropics (1,877 kg/ha). However, the average yield was somewhat lower in the subtropics (2,096 kg/ha) than in the temperate region (2,355 kg/ha). There was a striking difference in plant height. In the tropics, plant height was 49.5 cm,

much shorter than the 71.4 cm in the subtropics. Likewise, the difference in height was greatest between the subtropics, 60.2 cm, and those in the temperate region, 89.4 cm. The weight per seed was surprisingly greatest in the tropics and became smaller in the subtropics and temperate zone. The association of yield with various characteristics was studied through correlation analysis. Yield was negatively associated with seed quality and positively associated with seed weight. Its association with days to flowering and days to maturity was not apparent. The relative yield of late cultivars was lower with increasing distance from the equator and increasing altitude. These results indicate that there are cultivars of soybeans nearly as well adapted in the tropics as other varieties are adapted in the temperate regions.

Yield Trial Performance in Puerto Rico and Texas. The 1982 SIEVE was composed of 33 entries contributed by the following sources: two each from Bangladesh, Colombia, Senegal, and Sri Lanka; six entries each from India and Puerto Rico; four from Taiwan; seven from the U.S. (including two checks), and one from Zimbabwe. The origin of these entries represented a range of latitude from approximately 32°N to approximately 20°S. The trial was also planted in Texas, Colombia, and Sri Lanka but this report contains data from Puerto Rico and Texas only. The entries were arranged in a randomized complete block design with two replications and three row plots one meter long and 65 cm apart. The central row was harvested for seed yield.

Significant yield differences among entries were found in Puerto Rico but not in Texas. Mean seed yields ranged from 2,731 to 4,188 kg/ha in Puerto Rico and from 929 to 2,419 kg/ha in Texas. Two of the high yielding cultivars in Puerto Rico, Duocrop from the U.S. and KHSB-2 from India, were were also high yielders in Texas. All entries matured later and grew taller in Texas. This prolonged growth, however, did not have a favorable effect on yield at this location. A new selection from Jupiter, registered as Jupiter R, did not show significant differences with the parental cultivar in yield, plant height, or plant maturity at either location (Tables 4 and 5).

The 1982 SPOT was composed of 16 entries selected from the 1981 SIEVE trial. There were three cultivars from Brazil, one each from India, Panama, Peru, Guyana, and Zimbabwe, and four each from Mexico and the U.S. (including three checks). The experiment was planted in three replications with four row plots, 3.5 m long and 68 cm apart. The two central rows were harvested for seed yield.

Cultivars IBP-185-77 from Brazil, Duocrop from the U.S., and Rosales from Mexico had significantly higher yields than the check cultivars Jupiter and Bossier. With the exception of Baru from Panama all cultivars exhibited earlier maturity than Jupiter, indicating that a subtropical environment would appear more suitable for this germplasm. Plant height also showed significant variation among entries with the entries from Panama and Guyana being significantly taller than Jupiter. None of the entries were significantly shorter than the short checks Bossier or Davis. The high yielding test cultivars showed low to intermediate plant height (Table 6).

Table 4. Yield Performance of 1982 SIEVE Cultivars in Puerto Rico and Texas

Cultivar	Origin	Yield (kg/ha) P.R.	Texas	X
Duocrop	U.S.A.	4,188	2,277	3,233
KHSB-2	India	4,152	2,380	3,266
Supreme	U.S.A.	4,050	1,526	2,788
ICA-L-132	Colombia	3,990	1,625	2,808
Davis	U.S.A.	3,980	2,174	3,077
Jupiter-R	U.S.A.	3,784	1,639	2,712
PR 13 (114)	Puerto Rico	3,691	1,504	2,598
PR 142 (3)	Puerto Rico	3,676	1,495	2,486
Santa Rosa-R	U.S.A.	3,660	2.123	2,892
PR 211 (339)	Puerto Rico	3,538	1,798	2,718
Jupiter	U.S.A.	3,604	1,462	2,533
PR 141 (9)	Puerto Rico	3,591	1,497	2,544
PM-78-8-5-19	Sri Lanka	3,564	1,639	2,602
ICA-L-131	Colombia	3,374	1,843	2,609
PM-78-13-5-12	Sri Lanka	3,357	1,901	2,629
PM-78-2-5-25	Sri Lanka	3,347	2,419	2,883
AGS-154	Taiwan	3,340	1,232	2,286
PR 13 (153)	Puerto Rico	3,315	987	2,151
PR 21 (309)	Puerto Rico	3,275	1,265	2,270
269/5/3/2	Zimbabwe	3,231	----	----
MACSK-101	India	3,130	1,787	2,459
AGS 162	Taiwan	3,073	1,438	2,256
NA-2	India	3,011	1,446	2,229
N-23-A	India	2,921	2,201	2,561
CO-1	India	2,821	1,882	2,352
N-22	India	2,776	946	1,861
Williams-82	U.S.A.	2,759	2,135	2,447
ISRA-IRAT 178/74	Senegal	2,759	----	----
BS-23	Bangladesh	2,731	929	1,830
Mean		3,406	1,719	2,563
C.V.		10%	27%	----
LSD 0.05		728	NS	----

Table 5. Maturity and Plant Height of 1982 Cultivars in Puerto Rico and Texas

Cultivar	Maturity (days)		Plant height (cm)	
	P.R.	Texas	P.R.	Texas
Duocrop	95	117	82	94
KHSB-2	101	133	78	101
Supreme	101	149	74	107
ICA-L-132	95	125	89	90
Davis	94	118	52	62
Jupiter-R	100	148	91	114
PR 13 (114)	98	160	98	120
PR 142 (3)	101	144	92	98
Santa Rosa-R	93	146	56	114
PR 21 (339)	101	154	89	132
Jupiter	102	155	84	108
PR 141 (9)	103	140	89	99
PM-78-8-5-19	92	135	114	140
ICA-L-131	91	115	104	95
PM-78-13-5-12	96	139	97	119
PM-78-2-5-25	97	128	57	86
AGS-154	86	98	64	81
PR 13 (153)	102	150	91	109
PR 21 (309)	103	161	79	109
269/5/3/2	94	----	49	---
MACSK-101	88	142	97	114
AGS 162	90	122	64	70
NA-2	89	139	94	109
N-23-A	88	131	39	90
CO-1	90	125	104	122
N-22	95	138	45	80
Williams-82	84	90	55	75
ISRA-IRAT 178/74	100	----	57	---
BS-23	83	110	71	90
Mean	94	133	78	101
C.V.	1%	14%	8%	11%
LSD 0.05	3	N.S.	13	24

Table 6. Agronomic Performance of 1982 SPOT Cultivars Tested at the Isabela Research Sub-Station

Cultivar	Kg/ha	Maturity (days)	Plant Height (cm)	Origin
IPB-185-77	3,445	106	62	Brazil
Rosales-80	3,376	105	46	Mexico
Duocrop	3,128	107	64	U.S.A.
Davis	3,005	104	46	U.S.A.
CM	3,001	102	70	Mexico
PK 308	2,978	111	44	India
Huites 77	28,843	98	37	Mexico
Florida	2,778	111	53	Brazil
BR-1	2,734	110	49	Brazil
BM-2	2,614	101	40	Mexico
Sable	2,529	109	67	Zimbabwe
Jupiter	2,462	124	80	U.S.A.
Tulumayo-2	2,441	114	72	Peru
Baru	2,420	127	114	Panama
Bossier	2,351	107	44	U.S.A.
IGH-23	2,290	122	90	Guyana
Mean	2,775	110	61	
C.V.	12%	3%	10%	
LSD	539	1	10	

The 1982 ISVEX had 26 entries originating in Brazil, Colombia, Ecuador, Guyana, Honduras, Senegal, U.S. and Zambia. The experiment was planted in four replications with four row plots, 5 m long and 68 cm apart. The two central rows were harvested for seed yield.

Although the entries from Honduras and Guyana yielded more than 3,000 kg/ha, their yield levels were similar to those of the check cultivars Davis, Improved Pelican, and Jupiter. Most test entries were superior in yield to the check varieties Bossier and Williams. Plant maturity ranged from early to late with one entry from Guyana and one from Colombia being significantly later than Jupiter and no entry being significantly earlier than Williams. Most entries ranged in maturity between the two checks Davis (109 days) and Jupiter (122 days). Plant height among entries was highly variable ranging from very short in Bossier to very tall in ICA-L-125. Some short cultivars like Davis or Foster produced seed yields similar to the tall, high yielding cultivars SIATSA-194 and IGH-24 (Table 7).

Table 7. Agronomic Performance of 1982 ISVEX Cultivars Tested at the Isabela Research Sub-Station

Cultivar	Kg/ha	Maturity (days)	Plant Height (cm)	Origin
SIATSA 194	3,037	111	97	Honduras
IGH-24	3,004	127	88	Guyana
Ecuador 2	2,792	123	60	Ecuador
Foster	2,718	104	30	U.S.A.
UFV-1	2,680	121	46	Brazil
Davis	2,667	109	43	U.S.A.
Imp. Pelican	2,661	110	91	U.S.A.
Jupiter	2,595	122	73	U.S.A.
IGH-23	2,571	121	82	Guyana
Alamo	2,534	118	54	U.S.A.
ICA-L-125	2,492	139	111	Colombia
ICA-L-109	2,393	121	89	Colombia
ISRA 44A/73	2,092	120	62	Senegal
Williams 82	1,891	96	42	U.S.A.
Bossier	1,887	108	29	U.S.A.
7138	1,829	123	48	Zambia
Mean	2,490	117	65	
C.V.	16%	1%	9%	
LSD	569	2	8	

Germplasm Hybridization. Work on development of improved germplasm for tropical and subtropical environments centers on three main objectives: combine high yield potential with tropical and subtropical adaptation and an improved plant canopy; develop insect resistant lines with proper maturity and plant type for low latitudes; and develop lines with extended seed storability under ambient conditions in the tropics and subtropics.

Breeding for Tropical and Subtropical Adaptation. Evaluation results in the international variety trials are the basis for selecting germplasm to be hybridized to meet this objective. The main traits to be considered are seed yield, plant maturity, plant height, and plant canopy. Breeding populations are advanced from early to late generations by the single seed descent or pedigree methods, and selected genotypes are tested for yield in the F_6 generation. Two generations are produced per year and a given planting comprises several populations and different generations. The crossing blocks for the production of F_1 seeds during the winter season of 1982 involved 14 different parents from which a total of 31 hybrid combinations were obtained. The F_1 seeds of these combinations were planted for hybrid confirmation and generation advance during the winter season 1982/83.

F_1 seeds were also produced early in the spring of 1982 and planted during the summer of the same year for hybrid confirmation and generation advance. A total of 59 confirmed hybrid combinations were planted in the winter season 1982/83 to produce F_2 seeds.

F_2 populations from 27 crosses involving 10 parents were planted during the summer season of 1982 and advanced to the F_3 generation by the single seed descent method. The F_3 was again planted in the winter season 1982/83 to produce the F_4 generation.

The most advanced breeding materials planted in the summer of 1982 were 1,525 lines in the F_4 generation which were derived from 44 hybrid combinations as reported in 1981 (see IPR-81-1, Table A-17). These materials, which were advanced by the pedigree and bulk methods, generated 750 plant selections at the end of the growing season. Further selection on the basis of seed characteristics reduced these selections to 496, which were planted as F_5 rows during the winter 1982/83. The performance of these progenies during the winter season will help to predict plant growth in tropical and subtropical environments, allowing the breeders to visually select F_6 lines to be agronomically evaluated in replicated trials during the summer of 1983.

Breeding for Insect Resistance. A group of 89 lines derived from the insect resistance research of the University of Illinois at Urbana-Champaign were planted at Isabela in two row plots, 5 m long, during the summer of 1982. The purpose was to rate leaf and seed damage and to select promising germplasm for further breeding work. Cultivar Davis was planted as a check. Leaf damage was very low and appeared uniform in all lines and check plots. At harvest, three random samples of 50 pods each were taken and threshed by hand to evaluate seed damage by the pod borer *Etiella zinckenella* (Lepidoptera:Pyralidae). No seed damage was found in the test lines or in the check cultivar.

Insect resistance work will become an increasingly important component of the breeding work because of its practical application in soybean production in small farms of LDCs. New breeding populations are being developed at Isabela by crossing the resistant sources Pl 227687 and Pl 229358 with Jupiter, Alamo, Davis, Tunia, and others to derive lines combining tropical adaptation and insect resistance. Five F_2 populations from crosses involving the resistant parents were planted in the winter season 1982/83, and six new hybrid combinations with the same resistant parents were also produced in the same season. All progenies will be handled by the single seed descent method until the F_6, at which time tests for insect resistance and agronomic performance will be conducted in Puerto Rico or in cooperating countries.

Breeding for Seed Quality. Seed viability of commerical soybean varieties is of short duration under ambient storage conditions. In tropical regions where relative humidity and air temperature are high, the life of the soybean seed is even shorter. Breeding work has been initiated to find a solution to this problem by developing improved lines with tropical adaptation and seed longevity under ambient storage conditions. Plant breeders at IITA have identified germplasm with good seed storability and we in INTSOY are

using it to cross to other improved agronomic types. Moreove IITA and INTSOY have agreed to collaborate in a project to collect and test soybean germplasm with promising seed storability and to distribute genetically improved seeds to soybean researchers of tropical regions. Screening for seed longevity in heterogeneous materials was done at Isabela between October, 1981, and October, 1982, using 81 F_3 populations from crosses made with different purposes in previous seasons. The test materials were stored at room temperature and germination tests conducted after 9 and 12 months of storage. About half of the populations lost germination percentages between 20 and 98%; four of these populations had germination percentages between 80 and 98%. The second germination test showed that after 12 months the four promising populations still had germination percentages between 40 and 70%. These promising populations were derived from the crosses Orba x UFV-1, Orba x Improved Pelican, Santa Maria x Orba, and Santa Maria x Almo. The populations will be advanced and tested for seed storability and agronomic performance in future growing seasons.

Line Testing and Selection. Lines developed through hybridization and selection are advanced to homozygosity and then evaluated in preliminary yield tests. Promising materials in these tests are selected for international trials. There were two tests of breeding lines in 1982.

Breeding Lines Test No. 6 (BLT-6). Lines included in this test were developed by hybridization and selection with the purpose of combining high yield and appropriate levels of plant maturity and plant height for tropical environments. There were 46 breeding lines and six check entries compared in a randomized complete block design with four replications and three row plots 4 m long and 68 cm apart. The central row of each plot was harvested for seed yield. About 60% of the lines yielded more than 3,000 kg/ha but few of them yielded signficantly more than the high yielding checks. Plant maturity in all lines was later than the early maturity checks Davis, Bossier, and D75-1094, and showed maturities that ranged between Improved Pelican and HLS. Plant height in all lines appeared appropriate for tropical environments. If cultivated in subtropical environments or in long growing seasons these lines may exhibit moderate lodging (Table 8).

Table 8. Agronomic Performance of Advanced Generation Lines Tested in the BLT-6 at the Isabela Research Sub-Station in 1982

Line or check	Yield (kg/ha)	Maturity (days)	Plant height (cm)
PR 21 (18)	3,713	123	85
PR 30 (32)	3,380	123	93
PR 38 (41)	3,333	126	83
PR 30 (34)	3,325	124	97
PR 30 (38)	3,316	119	102
PR 30 (37)	3,314	123	94
PR 13 (10)	3,310	119	85
PR 15 (13)	3,309	115	110
PR 30 (36)	3,307	123	88
PR 30 (31)	3,261	122	87

Table 8. (Cont'd)

Line or check	Yield (kg/ha)	Maturity (days)	Plant Height (cm)
PR 30 (29)	3,213	121	91
PR 13 (6)	3,207	114	92
PR 13 (9)	3,188	119	73
PR 38 (44)	3,149	124	105
IAC-73-1385	3,143	113	73
PR 21 (22)	3,101	123	78
PR 21 (23)	3,073	127	83
HLS	3,067	127	77
PR 30 (39)	3,060	124	94
PR 8 (1)	3,055	113	111
PR 13 (4)	3,045	126	112
PR 13 (11)	3,016	126	85
PR 21 (25)	3,015	126	94
PR 38 (42)	3,011	120	87
PR 15 (14)	3,008	129	94
Bossier	3,007	112	50
PR 13 (3)	3,006	121	84
PR 21 (20)	3,006	118	78
PR 21 (16)	2,990	123	83
PR 21 (26)	2,990	127	81
Davis	2,961	110	42
Pr 30 (35)	2,934	125	96
PR 27 (28)	2,932	125	83
PR 30 (40)	2,930	121	89
PR 30 (33)	2,925	119	97
PR 13 (8)	2.921	122	90
PR 21 (19)	2,920	126	83
Imp. Pelican	2,983	114	84
PR 30 (30)	2,890	120	88
PR 21 (24)	2,881	129	92
PR 21 (17)	2,876	126	79
PR 13 (7)	2.863	122	78
PR 13 (2)	2,838	117	92
PR 15 (15)	2,764	128	114
PR 13 (5)	2,730	115	79
PR 15 (12)	2,722	129	127
PR 30 (27)	2,701	118	88
PR 21(21)	2,668	126	89
D 75-10-194	1,873	108	35
Mean	3,024	121	87
C.V.	13%	1%	7%
LSD 0.05	570	2	9

A group of 25 of the lines tested in BLT-6 was sent to Bolivia for observation at a latitude of 18°S. The lines were planted at El Chaco Research Station in February, 1982, by Ing. Roberto Delgadillo of the Instituto Boliviano de Tecnologia Agropecuaria (IBTA), who found six lines agronomically superior to the commerical checks Jupiter and V-1 and selected them for further testing and incorporation in his breeding program. Plant breeders from Colombia and Guatemala have also requested these lines for their research programs.

Agronomic Test of SMV Resistant Lines. Another test conducted at Isabela with advanced generation lines was for SMV (soybean mosaic virus) resistant lines test. The lines were developed in collaboration with INTSOY plant pathologists and the test was conducted with the purpose of evaluating the agronomic performance of 20 SMV resistant genotypes. A randomized complete block design with three replications was used. The plot size consisted of three rows, 4 m long and 68 cm apart. The central row was harvested for seed yield. Although yield levels were relatively high (2,863-3,418 kg/ha), no significant yield differences were found among lines due to a large error variance. Plant maturity was similar to Improved Pelican or Jupiter, which indicated that the lines may also be adapted to tropical latitudes. Another desirable feature of these lines for tropical adaptation is their height, which varies from medium to tall (Table 9).

SMV resistant lines were also sent to Pakistan and AVRDC for testing under local conditions. A report by Dr. Silvia K. Green of AVRDC indicated that although the lines appeared free of SMV they did not have the right maturity for the conditions of Taiwan.

Seed Increases. Seed increases for the international trials SPOT and ISVEX are carried out each year during the winter season at the Isabela Research Sub-Station. In 1982, 1,139 kg of planting seed were produced for international trials. Of this total, 75 kg were for 11 SPOT cultivars and 1,064 kg for 20 ISVEX cultivars. After harvesting and threshing, the seeds were cleaned by hand and then shipped to the Agronomy Department, University of Illinois, for packing, labeling, and distributing to international cooperators.

Table 9. Agronomic Performance of SMV Resistant Lines Tested at the Isabela Research Sub-Station in 1982

Line or check	Yield (kg/ha)	Maturity (days)	Plant height (cm))
PR 141 (9)	3,418	120	70
Bossier	3,400	112	57
Jupiter	3,387	125	91
PR 141 (4)	3,195	125	83
PR 142 (3)	3,193	122	93
PR 141 (17)	3,132	119	85
Impala	3,112	106	58
PR 141 (7)	3,022	120	87
PR 143 (22)	2,986	125	92
PR 142 (8)	2,949	122	79
PR 143 (15)	2,939	120	71
PR 142 (1)	2,920	122	94
PR 143 (12)	2,918	126	88
Imp. Pelican	2,711	117	92
PR 143 (13)	2,702	127	69
PR 139 (6)	2,667	122	77
PR 141 (24)	2,665	117	82
PR 143 (14)	2,613	120	49
PR 142 (5)	2,579	119	75
PR 141 (16)	2,577	124	75
PR 143 (23)	2,522	123	83
PR 140 (2)	2,432	119	59
PR 140 (11)	2,381	119	66
PR 139 (10)	2,280	122	71
Mean	2,863	121	77
C.V.	20%	2%	13%
LSD 0.05	NS	4	17

IMPROVED RHIZOBIUM JAPONICUM TECHNOLOGY FOR THE TROPICS

Microbiology research on *Rhizobium* was carried out by INTSOY staff at the University of Puerto Rico, Mayaguez Campus. Field experiments were conducted at the Corozal Experimental Station, Corozal, Puerto Rico.

Serological Assay of Soybean Nodules from Plots Previously Inoculated with Commercial Inoculant. In 1981, 16 soybean cultivars (an INTSOY ISVEX "A" Trial) were planted at two liming levels (native pH approximately 4.7, and enough lime to neutralize the aluminum giving a final pH of approximately 6.5) at the Corozal Experimental Station. Each cultivar was replicated twice with normal fertility (P, K and Mg) and herbicide practices utilized.

The purpose of this experiment was to ascertain the influence of cultivar on the population and distribution of the *Rhizobium japonicum* introduced into the soil in previous experiments (see IPR-81-1). Nodules were collected and serology performed on the nodules.

The distribution of the initial serological data conducted on nodules from Lee and Davis cultivars indicted that approximately 85% of the nodules were formed by strain 61A101. The results of the serological data for the ISVEX trial showed a definite shift in distribution of organisms forming the sampled nodules. Distribution for *Rhizobium japonicum* strains 61A101, 61A118, 61A124, 61A148 and unknown were 48.15%, 4.26%, 31.89%, 10.18% and 5.55% respectively.

Statistical analysis of the interaction of cultivar, lime, organism and replications indicted signficant interactions between cultivar and organisms, as shown in Tables 10 and 11.

Table 10. Results of ANOVA and Duncan's Multiple Range Test on the Interaction of 16 Soybean Varieties with Rhizobium japonicum Strain 61A101

Cultivar	Mean percent of nodules formed by 61A101	Results of Duncan's Multiple Range Test at the 1% level
IGH	80.00	a
Williams	73.75	ab
IGH - 24	65.50	abc
Jupiter	65.00	abc
UFV-1 (BP-2)	60.00	abc
UFV-1	57.50	abc
Bossier	57.50	abc
Tunia	53.75	abc
Ecuador - 2	51.25	abc
Caribe	47.50	abcd
Foster	40.00	bcde
Alamo	35.00	cdef

Table 10. (cont'd)

	Mean percent of nodules formed by 61A101	Results of Duncan's Multiple Range Test at the 1% level
Davis	35.00	cdef
ACC - 2120	13.75	def
SJ - 2	10.00	ef
Imp. Pelican	3.75	f

Table 11. Results of ANOVA and Duncan's Multiple Range Test on the Interaction of 16 Soybean Varieties with Rhizobium japonicum Strain 61A124

Cultivar	Mean percent of nodules formed by 61A2140	Results of Duncan's Multiple Range at the 1% level
Imp. Pelican	82.50	a
SJ - 2	66.25	ab
ACC - 2120	50.00	abc
Davis	35.00	abc
Caribe	31.25	bc
Bossier	31.25	bc
Foster	28.75	bc
Alamo	25.00	bc
UFV-1 (BP-2)	23.75	bc
Ecuador - 2	23.75	bc
UFV - 1	22.50	bc
IGH - 24	21.50	bc
Tunia	21.25	bc
Williams	21.25	bc
Jupiter	20.00	bc
IGH - 23	7.50	c

It is interesting to note that Davis, which showed 85% residency of strain 61A101 in 1980, occupied only 35% of the formed nodules in 1981. It is also obvious that, with the cultivars tested, there are specific host/strain relationships that should be considered when recommending certain cultivars.

This experiment was repeated at Corozal in 1982 and serology will be done on the collected nodules. More information is needed concerning the influence of rainfall, soil type, altitude, date of planting, etc. on the cultivar/-*Rhizobium* spp. relationship.

Rhizobium japonicum Longevity Study on Acid, High Aluminum Corozal Soil. A longevity trial was started at the Corozal Experimental Station in 1980 utilizing Jupiter with 8 individual strains or a combination of all the strains. Each organism was replicated 4 times at 2 levels of lime (0 and 1,800

kg/ha). See IPR-81-1 for a more detailed explanation of the experimental parameters. This experiment was continued through 1982. Production parameters showed similar variations to the previous years data. Yield of the longevity plots are presented in Table 12.

Table 12. Yield of the Longevity Plots at the Corozal Experimental Station

Rhizobium japonicum strain	Yield from limed plots (kg/ha)	Yield from unlimed plots (kg/ha)	Yield by org. (kg/ha)
61A118	3,062.8	2,409.4	2,736.1
USDA 58	2,681.5	1,994.5	2,338.0
61A101	3,111.4	2,394.6	2,753.0
USDA 110	2,328.3	1,512.8	1,920.6
61A148	2,432.4	2,629.9	2,531.2
587 (Brazil)	2,487.9	2,550.2	2,519.1
29W (Brazil)	2,171.5	2,276.5	2,224.0
61A124	2,135.9	1,546.8	1,841.4
Mixture	2,333.7	2,508.1	2,420.9
Control[a]	2,205.9	1,819.3	2,012.6
Average	2,495.1	2,164.2	2,329.7

[a]The controls were effectively nodulated.

Serological testing of the nodules from this experiment have not been completed due to a shortage of antiserum. The experiment will be completed in early 1983.

Interaction of Strains of Rhizobium japonicum in Combination with Various Strains of Azotobacter spp. and their Effect on Growth and Nodulation of Soybean. With the encouraging results of the interaction observed between *Rhizobium japonicum* strains USDA 110 and 71A101 and *Azotobacter beijerinckii* and *A. chroococcum* (see IPR-81-1) it was decided to study additional *Rhizobium* and *Azotobacter* strains in the greenhouse.

Rhizobium japonicum strains TAL 184 and USDA 123 were used in combination with *A. beijerinckii*, *A. chroococcum* and *A. vinlandii*. Preparation of the Leonard jars and the seeds were similar to the previously conducted experiment (see IPR-81-1). Rates of an actively growing 4 day old *Azotobacter* culture were 0, 1 and 1.5 ml/seed. Each treatment was replicated three times.

The interactions of *Rhizobium japonicum* strain USDA 123 with *A. beijerinckii* and *A. chroococcum*, at 1 ml, were highly stimulatory over strain 123 alone for all parameters measured (number of nodules, nodule dry weight, shoot and root weight). Both *Azotobacter* species, in particular *A. beijerinckii*, showed a depressing effect at the higher rate. *A. vinlandii* had only a slightly stimulatory effect but overall was equal to the control.

Rhizobium japonicum strain TAL 184 showed a completely different pattern of reaction to the presence of *Azotobacter*. The number of nodules, for all

combinations, was depressed below TAL 184 alone. However, nodule weight, shoot and root weights all approximated the values observed for the inoculated control. The combination of TAL 184 and *A. vinlandii* applied at 1.5 ml/seed had a tremendously depressing effect for all parameters measured. The values observed were similar to the noninoculated controls.

Further investigation into this phenomena as well as continued testing of different *Rhizobium japonicum* strains is planned.

Control of Moisture Loss from Granular Peat. Several high temperature (70° C) incubation studies were conducted utilizing various rates of mineral oil and glycerol as a coating agent in an attempt to reduce the moisture loss in peat.

Two methods of application were utilized in applying the mineral oil and glycerol to the granular peat. The first method added the coating agent to the hydrating liquid prior to moistening the peat. The second method applied the coating agent to peat granules 24 hours after the peat had been moistened. Fifty gram samples of peat, moistened to 40% (wet weight basis), were used for this experiment. Rates of mineral oil were 0, 1, and 4 ml/50 gram sample and rates of glycerol were 0, 1, 7, and 10 ml/50 gram sample. Each treatment was replicated 3 times. The samples were incubated at 70° C and weighed every 24 hours until moisture loss reached a steady rate.

The first method provided very inconsistent results. All rates of mineral oil were no different than the control. The 1 ml glycerol treatment was the same as the control, the 6 ml rate showed a moisture loss rate considerably higher than the control while the 10 ml rate was considerably lower than the control.

The second method proved considerably more consistent. There were no differences between any of the mineral oil or glycerol treatments. They were all, however, below the control. The maximum differential equated to approximately 4.2 grams of additional moisture/50 gram in both the glycerol and mineral oil treatments over the control.

In the International Inoculant Shipping Experiment (IISE), good correlation was shown between moisture loss and decline of the *Rhizobium* population. Using this graph, it was determined that with an additional 4.2 grams of water there would be a corresponding increase in the *Rhizobium* population of approximately 4 million cells. This is an adequate population itself to provide good nodulation.

Longevity studies are currently planned where *Rhizobium* populations will be inoculated into the granular peat and the samples incubated at a more reasonable temperature (35° C). Moisture content versus *Rhizobium* population versus time will be determined.

Vermiculite as a Possible Inoculant Carrier. Studies were conducted using various sizes of vermiculite to determine if size of the vermiculite particles had an influence on survival of *Rhizobium*.

Vermiculite was passed through various size sieves and separated into small (less than 4 mm), medium (between 4 and 4.75 mm), and large (greater than 4.75 mm) particles. Moisture holding capacity was determined by saturating the vermiculite samples with excess water for 24 hours. Non-absorbed water was drained off, the vermiculite weighed and then dried at 105° C. Moisture holding capacity was then calculated. Vermiculite samples of all three sizes were sterilized in the autoclave at 121° C for 1 hour. Thirty grams of each size were aseptically transferred into sterile sampling pouches and inoculated with *Rhizobium japonicum* strain 184. The liquid content of the vermiculite was 40% (wet weight basis) of the calculated moisture holding capacity. Two pin holes were placed in each bag with a sterile needle and covered with sterile cotton. The pouches were incubated at 35° C. Each treatment was replicated 3 times. Populations dynamics were determined weekly by plate count on mannitol, yeast extract agar. Each dilution was replicated 3 times and incubated at 30° C. Plate counts were made between 7 and 10 days after plating.

The small and medium sized vermiculite showed similar growth patterns of the introduced *Rhizobium*. The maximum population was attained within 3 weeks (approximately 320 million cells/gram of vermiculite) after which the population slowly declined. The large vermiculite particles allowed much higher population to initally develop, (approximately 750 million cells/gram of vermiculite) with a rate of decline similar to the populations in the small and medium sized vermiculite particles.

In this initial experiment it became quite clear that the larger vermiculite particles could support a very high population of introduced *Rhizobium* and that it appears to be superior to the small sized vermiculite particles.

Experiments will continue with the vermiculite and it will be compared to other carriers as well as granular peat.

Preconditioning of Strains of Rhizobium japonicum Prior to Introduction into Unsterile Peat. Several experiments have been conducted looking at the feasibility of preconditioning *Rhizobium* strains to make them more competitive when introduced into unsterile peat.

Peat extract was made by placing 250 grams of granular peat in one liter of distilled water and placed in the autoclave for 30 minutes. The resulting liquid was decanted off, half of which was mixed with 5 grams of charcoal (to clarify), the other half was kept as is. Both samples were then filtered through Whatman no. 4 filter paper and sterilized (15 minutes at at 121° C). Yeast extract, mannitol media was made up containing 0, 5, 10, and 20 ml of either clairified or non-clarified sterile peat extract (see IPR-81-1 for further background and details of previous experiments).

Turbidity experiments studying the effect of the prepared peat extract on *Rhizobium japonicum* strain 110 gave the indication that the higher the concentration of extract the greater the growth rate. This appeared to be true for both the cloudy and clear peat extract samples. Plate count data of the same samples contradicts these indications. From the plate count

data it appears that the non-clarified peat extract initially stimulated the *Rhizobium* population and produced a population slightly higher than the control at the end of the experiment. The clear peat extract showed a different type of growth curve. The initial counts showed a slight inhibatory effect of 10 and 20% and a slightly stimulatory effect at 5% over the control. When the populations in the cloudy samples, as well as the controls, were leveling off, the clear peat treatments were continuing to increase in numbers indicating a delaying effect of the clear peat.

Other strains will be "conditioned" to see if similar growth patterns are observed. Introduction into peat will follow.

Liquid Inoculant Production Under Non-Laboratory Conditions. As previously reported (see IPR-81-1), twenty liter collapsible plastic containers were chosen as an inexpensive, easily shipped container for production of test quantities of liquid inoculant under non-laboratory conditions. The containers were initially sterilized by gamma radiation which proved unsatisfactory. The gamma source has since been dismantled and no further attempts to use this method have been possible. Propylene oxide has been tried as well as chlorox and alcohol. A method that will consistently sterilize these plastic containers has not been found. Smaller (4 liter) collapsible containers were tried with the same results. The containers are made of polypropylene and are therefore non-autoclaveable. Autoclaveable containers are available but are very expensive and cannot be collapsed, thus making shipping more difficult and expensive.

Alternate containers are presently being looked at that would be available locally and that could be sterilized with locally available chemicals.

Isolation of Rhizobium japonicum Strains from Nodules Collected in Vietnam. On a recent trip to Vietnam, Dr. Joseph A. Jackobs (INTSOY Agronomist), collected several soybean nodules from 10 different locations. Several of these sites had no previous history of applied soybean inoculant. Others were growing INTSOY ISVEX Trials with applied Nitragin½ inoculant. The collected nodules were placed in vials with calcium chloride. Upon returning the United States Dr. Jackobs sent them to the Soil Microbiology Laboratory in Puerto Rico.

The nodules were surface sterilized with 5.25% sodium hypocholorite for 15 minutes and then rinsed 7 times with sterile distilled water. The nodules were placed in sterile test tubes containing 0.5 ml of sterile saline (0.85% NaCl) solution and allowed to rehydrate for 3-4 hours. They were then crushed and the liquid streaked out on mannitol yeast extract agar containing Rose Bengal. The media was made up at pH 7.0 and 5.5 to insure acid tolerant strains would not be overlooked. The plates were incubated at 30° C and checked daily for growth.

Within 24 hours after plating colonies were observed. The colonies were transferred to fresh plates and checked for purity. The original plates were continually checked for the next 10 days for colonies of slow growing *a@("_[(/# %¶?_<('/#*. The purified colonies were transferred to mannitol, yeast extract media containing 1% NaCl, as a selective media, as well as being examined under the microscope. Pure cultures were transferred to slants and stored at 4°C.

A total of 38 isolates were made, 14 of which were traditional slow growing types of *Rhizobium japonicum*. The remainder (24) were all fast growing isolates that were readily observed on the plates within 24 hours.

It was interesting to note that more fast growing isolates were obtained from nodules collected from the ISVEX Trials, with applied Nitragin® inoculant, than slow growers. One site that had never had inoculant applied yielded only slow growing isolates of *Rhizobium japonicum*. Greenhouse studies are planned to determine the effectiveness and cultivar compatibility of the 38 isolates.

Dr. Jackobs has also collected nodules from various sites in a recent trip to India. Several of these sites have never had inoculant applied and he reported good nodulation and apparent nitrogen fixation. These nodules will be processed as soon as possible utilizing the same techniques described for the Vietnam nodules.

Nodule Evaluation of Previous ISVEX Trials (NEPIT). The INTSOY trials trials which have been conducted under many different environments provide a unique opportunity to correlate soil type, latitude/longitude, altitude, and cultivar influencing the prevalence of *Rhizobium* strains. The NEPIT was established to study this.

Letters were sent out to 47 selected ISVEX/ISRIE cooperators defining the intent and purpose of NEPIT and the parameters necessary in order to make this a meaningful experiment. Ten of the 47 cooperators had participated in the ISVEX/ISRIE program within the last 3 years could accurately locate previous ISVEX/ISRIE Trials, had not applied inoculant to the plots within the last 6 months, and indicated an interest in participating in this trial. A total of 14 NEPIT experiments have been requested.

Instruction sheets were made up indicating the recommended procedures to follow and are summarized as follows:

- Accurately locate the previous ISVEX/ISRIE Trial.
- Select 2 of the 4 reps and mark off each plot, noting on the record sheet which variety was previously planted there.
- Till the middle 1.2 meters of each plot and incorporate the necessary potassium, phosphorus, lime, and trace elements (no nitrogen) to adequately support growth of the soybean plants.
- Plant 2 rows of soybeans (Davis cultivar supplied) 30 cm apart with 30 cm borders.
- Monitor the growth of the plots and utilize normal herbicides and pesticides procedures to insure optimum growth.
- Sample 5 plants from each row in each plot (total of 10 plants/plot) when the soybeans have 10-20% flowers.
- Harvest and count the nodules, separate the roots from the shoots and dry at 70° C, determine dry weight, and record on the data sheet.
- Carefully dry nodules at 70° C, weigh (if possible), and place in appropriately marked vials (provided).
- Return to the Soil Microbiology Laboratory in Puerto Rico the following: 32 vials containing nodules from 32 plots, the data sheet containing all the parameters requested, and the general information sheet

containing information such as soil type, rainfall/irrigation applied to soybeans, etc.

Once the nodules are received in this laboratory, serological studies will be made on the nodules using standard procedures. Once the serology is completed, correlations between soil type, latitude/longitude, altitude, etc. versus cultivar and prevalent strain of *Rhizobium japonicum* will be attempted.

Three of the 14 trials have been sent out with the remainder requested to be sent over the next 6 months.

IMPROVED DISEASE AND INSECT CONTROL

Research on disease and insect control is conducted at UIUC and collaboratively with scientists in several countries. The following summarizes the result of this research.

Effect of Soybean Mosaic Virus Infection on Plant Growth-Related Parameters and Yield of Williams Soybean. As reported previously (IPR-81-1), two field experiments were conducted to determine the nature of the yield loss caused by SMV. An understanding of the mechanism responsible for yield loss is important for several reasons. We know that some SMV strain/soybean genotype combinations lead to severe yield losses while other combinations do not. In advising soybean workers in developing countries on the use of genetic resistance or tolerance, we feel a need to better understand the interaction between the virus and the host plant. If the genetic determinants for yield severity are primarily plant determined, the use of tolerant varieties will be more stable and successful than if the determinants are primarily due to the variability and stability of the virus strain.

In these experiments, we have catalogued in detail the agronomic growth characteristics of a soybean cultivar. In the first year the plants were inoculated or not inoculated with a severe isolate of the virus, and in the second year inoculated with a severe or a mild isolate in comparison with noninoculated controls. For logistic reasons, these experiments were conducted at Urbana.

Results of the first experiment, not reported here in detail, suggested that the loss of yield due to SMV infection was due to a block in fertilization of the ovule by pollen. Virus-infected plants had more flowers at more nodes (i.e., vegetative and early reproductive development was stimulated by virus infection) but far fewer pods and seeds were produced on virus-infected plants. The possible implications of this finding, and confirmation by a more elaborate experiment, were explored in the second experiment and in work planned for the future.

The second study was performed from May to October, 1981, at Urbana to determine which of the vegetative growth-related parameters are directly affected by SMV infection over time and to relate such effects to the yield components and total yield of soybeans. The experiment was designed so that the data obtained would be useful to develop a computer model relating SMV spread, vector activity, soybean plant growth, and yield loss, in addition to the points covered above.

Mild and severe isolates of soybean mosaic virus strain G2 (SMV-G2) were used in this study, as well as a healthy control. Sampling for the growth-related parameters started 15 days after inoculation and once after every two weeks until harvest. Ten samples per plot were used to determine the following: plant height, leaf area, number of nodes, number of flower clusters, number of pods, fresh weights of leaves, stem, pods, and flower clusters, and their corresponding oven dry weights.

For yield, all the plants in the two center rows of each plot were counted and cut at harvest. Random samples of ten plants were picked and the number of unfilled pods, pods with 1, 2, 3, or 4 seeds, and the total number of pods per plant were determined.

The results, currently being fully analyzed, indicate that the mild isolate reduced yields by 20 percent and the severe isolate 70 percent. The loss appeared to be directly due to the reduced number of seeds per pod, greater number of unfilled pods, and the reduced size of seed in infected plants (see Tables 13 and 14). The total number of pods per plant was not affected. In a subsequent report results of the effect on vegetative and seed parameters will be presented in detail.

Soybean Mosaic Virus Epidemiology. Research continues to be aimed at the long-range goal of understanding the large number of ecological factors that affect the spread and damage caused by soybean viruses. We know that seed transmission is one of the primary factors in long distance movement of SMV, and we wanted to know its role in the spread of a virus through a field and the amount of infected seed produced in that field.

Field experiments were conducted in 1980 and 1981. Results from the 1980 experiment and details of the methods were reported previously. The plots planted in 1981 were harvested in 1982. These data are still in the process of analysis; however, several points can be made.

The amount of seed transmission seems to be greater in the 1981 experiment than was shown in 1980. In 1981, there was a significant correlation between rate of seed transmission and the initial and final rates of infection; the greater the number of initially infected plants the greater will be the number of infected seeds produced in that field.

In 1981, as in 1980, the initial rate of infection was significantly correlated with the final rate of infection and yield. However, though there seemed to be a relationship between initial infection rate and seed coat mottling and rate of seedborne *Phomopsis*, these correlations were not statistically significant, and the two latter parameters were more closely tied to the final rate of infection. No correlations were seen between the level of infection (either initial or final) and seed germination or seed weights.

We still conclude that plants grown from infected seeds do not directly contribute to seed transmission at harvest, because their infection is so severe that they do not produce viable seeds. However, they do act as a source of virus (spread by aphids) to other mature plants which, when infected at a later stage, will produce seeds some of which will be infected. The amount of spread will be related to the numbers and activities of vectors in the field.

Table 13. Factors Directly Determining Yield in Soybeans Infected with Soybean Mosaic Virus--1981 Data

Treatment		Yield (kg/ha)	No. of Seeds/Pod	Size of seed (g/100 seeds)	No. of Pods/Plant	No. of Plants	No. of Seed/Plant
Healthy		1,777.0a	2.61a	18.18a	44.73	94.8	117.5a
Infected:	SMV Mild Isolate	1,417.2a	2.37a	15.7 b	47.68	73.8	113.4a
Infected:	SMV Severe Isolate	532.3b	1.95b	12.13c	38.33	87.0	75.0b
FLSD		413.4	0.24	1.01	NS	NS	24.65
C.V.		19.23	6.17	3.78	13.37	15.85	13.97

Table 14. Average Number of Pods with Zero, One, Two, Three, or Four Seeds

Treatment		Number of Seeds/Pod				
		Zero	One	Two	Three	Four
Healthy		1.23a	2.63a	8.03a	32.63a	0.23
Infected:	SMV Mild Isolate	1.68a	5.50a,b	13.73	26.63a	0.15
Infected:	SMV Severe Isolate	3.43b	8.28b	13.20b	13.43b	0.00
FLSD		0.79	3.28	4.11	6.98	NS
C.V.		21.74	34.69	20.40	16.64	104.1

Influence of Strain Identity on Seed Transmission of SMV. As mentioned in IPR-81-1, different strains of SMV were observed to have different rates of seed transmission in certain temperate soybean cultivars. We wanted to determine (1) the range in variability of transmission, and (2) whether there were any tropical lines which did not transmit any of the strains. In March, 1981, eight tropical lines (Arisoy, Improved Pelican, Jupiter, PI 203.406, PI 325.779, PI 340.901, PI 341.256, and UFV-1) were inoculated with the seven strains of SMV in the field in Isabela, Puerto Rico. Seeds harvested in June, 1981, were planted in the greenhouse in Urbana to check for germination and seed transmission rates. The data from these experiments have been collected and collated, and analysis has begun.

The results indicate that there is a wide variety in seed transmission of SMV depending on both the strain and the cultivar (Table 15). Five lines (Arisoy, Improved Pelican, PI 203.406, PI 341.256, and UFV-1) transmitted all seven strains at a rate of less than 1 percent. Strains with the highest transmission percentages were G1, G2, G5, and G6. Transmission of G1 was most common and of G7 least common (Table 15).

Table 15. Percentage Seed Transmission of Indicated SMV Strains Eight Tropical Soybean Cultivars

Cultivar	Strain						
	G1	G2	G3	G4	G5	G6	G7
	Percent						
Arisoy	0.12	0.05	0.0	0.15	0.12	0.00	0.00
Improved Pelican	0.05	0.10	0.45	0.00	0.05	0.12	0.00
Jupiter	2.60	0.75	0.20	0.40	1.58	1.45	0.10
PI 203.406	0.92	0.48	0.00	0.10	0.82	0.75	0.20
PI 325.779	0.15	1.75	0.60	0.10	3.20	2.45	0.00
PI 340.901	6.80	1.45	0.78	0.52	3.70	1.78	0.15
PI 341.256	0.00	0.05	0.65	0.10	0.00	0.70	0.00
UFV-15	0.05	0.00	0.00	0.23	0.07	0.13	0.00

Influence of Mixed Strain Infection on Seed Transmission of SMV. Previous INTSOY annual reports have documented the recognition of seven distinct strains of SMV by symptomatology and immunity in eight differential soybean cultivars. Continuing the research program designed to control losses due to SMV infection by development of SMV-resistant cultivars, we have used five of the seven strains to evaluate the effect on seed transmission rates of two strains simultaneously infecting a single host plant. Several strains of SMV are commonly found in a given soybean-producing area. In a breeding program for development of resistance to certain strains or groups of strains, we must know the effect of a mixed infection on transmission rates of the strains involved. If one strain dominates in a mixed infection and excludes other strains from being passed into the seed or lowers their rates of transmission, it could lead to misleading results and mistakes in breeding directions.

SMV strains G2, G3, G4, G5, and G6 were chosen for study because certain combinations of these five strains can be identified using the eight differential soybean cultivars. The combinations used were: G2 and G4, G2 and G5, G3 and G4, G3 and G5, and G3 and G6. Strains were obtained from dried and frozen soybean tissue prepared and tested for identity as described in IPR-81-1. Soybean cultivar Midwest was used to test the effect on seed transmission rate because it has a very high rate of seed transmission, estimated at 28 percent. To prevent use of seedlings already infected with SMV via seeds, symptomatic seedlings were removed prior to inoculation with test strains. Seedlings which were used were also tested by ELISA to ensure that they were originally virus free.

For each strain combination, twenty plants were inoculated with one strain, twenty plants with the second strain, and twenty plants received inoculations of both strains, one on each of the primary leaves. To inoculate, dried tissue was rehydrated and ground in phosphate buffer containing carborundum. Inoculum was rubbed onto primary leaves or trifoliolate leaves with a Q-tip. Leaves were rinsed with distilled water. Five uninoculated control plants were included in each group. Plants were spaced in the greenhouse according to strains to minimize chances of contamination and were left to mature, flower, and set pods.

The experiment has been conducted to this stage. When seeds are mature they will be collected from each group of plants, rated for mottling, and planted in the greenhouse. Percent germination and percent seed transmission will be recorded, the latter verified by ELISA testing of all seedlings. For plants inoculated with two strains of the virus, the seedlings will be further tested by inoculation onto the appropriate differential cultivars to determine which strain, or both, were transmitted in that seed.

At this point it is apparent that flowering and seed set is greatly reduced in plants inoculated at the primary leaf stage as compared to controls. Therefore some combinations of virus strains are being repeated with inoculation of test plants at approximately two weeks prior to the onset of flowering rather than at the primary leaf stage. This should reduce the severity of the infection and allow the formation of a greater number of flowers and pods.

Use of SMV-Induced Male Sterility to Achieve Out-Crossing in Self-Pollinating Soybeans. The objective of this project is to develop the use of virus-induced male sterility for breeding of self-pollinating crops such as soybeans. Results of this project could conceivably lead to the first practical method for commercial production of F_1 hybrid seed of soybeans and other self-pollinating crop species. Methods applicable to self-pollinating plants that increase the frequency of natural outcrossing or facilitate large numbers of artificial crosses have been long sought by plant breeders and geneticists. Certain areas of plant breeding would be advanced by a convenient and highly restorable (reversible) method for inducing male sterility. This would be useful considering the importance of self-pollinating crops, such as wheat, soybeans, and rice, in world agriculture.

It has been long known that certain plant viruses cause male sterility in plants. However, very little study has been devoted to the mechanism of this phenomenon, and no study on the possibility of using virus-induced male sterility in genetics and plant breeding has been reported. Following on our recent discovery that certain soybean mosaic virus isolates cause partial or complete male sterility in infected plants, this research project was designed to elucidate the mechanism of virus-induced male sterility in soybeans. The project consists of a field experiment to determine the feasibility of using this method in obtaining a high frequency of outcrossing for use in quantitative genetics studies. The development of F_1 hybrid seeds in quantities large enough to make possible statistically meaningful tests of heterosis could possibly follow as a direct result of these experiments.

Virus-induced male sterility would have several advantages over both genic and maternally-inherited male sterility. In principle, it would be similar to maternally-inherited cytoplasmic male sterility (which is not yet known in soybeans) but without the disadvantages of the need for restorer genes to make its use practical. Possible disadvantages of the use of viruses for this purpose, such as transmission of the virus via insects and seeds, can be circumvented.

The field project consisted of two parts. The first part was designed to determine which, if any, of 20 randomly selected SMV isolates, including at least one isolate from each SMV group G1 through G7, could induce complete male sterility when inoculated onto Williams soybeans. SMV has previously been shown to induce male sterility in this cultivar. Furthermore, Williams is a widely used Group III soybean cultivar and it will continue to be important as it is now being used as a parent in many breeding programs.

Cumberland soybeans were planted in June, 1982, on the Plant Pathology Farm near Urbana, IL. The field was conventionally tilled and seeds were machine planted in 30-inch rows. Williams were hand planted in 3-foot sections within the Cumberland rows. After germination the Cumberland seedlings were removed from the 3-foot sections. The cultivar Cumberland has purple hypocotyl color and purple flowers, which are dominant traits. This coloring is easily distinguished from the white hypocotyl color and flowers of Williams (recessive traits). The experimental design was a two-factor factorial with date of inoculation and SMV isolate considered as factors. It was planted as a randomized complete block design with three replications.

Each three-row plot consisted of one row of Williams bordered on each side by a row of Cumberland. Each block was adequately separated to minimize interplot interference according to published reports.

Plots were inoculated with virus with an artist's airbrush. Half of the plots were inoculated 10 days after planting and the other half 21 days later. One week after inoculation all uninfected plants, based on symptomatology, were removed from the plots (except uninoculated controls). At harvest 10 plants were randomly selected from each plot and the total number of pods and the number of seeds per pod were counted. Other data were taken on the entire 3-foot row. These data included total yield, 100 seed weight, percent moisture, and percentage and degree of mottling.

One hundred seeds from each plot will be planted in a greenhouse sandbench during the winter of 1983. Data taken will be percentage germination, percentage SMV seed transmission, and degree of outcrossing. The latter will be determined by noting hypocotyl color. The percentage of purple hypocotyl color reflects the frequency of outcrossing and, hence, the frequency of virus-induced male sterility. Results of this experiment will be reported in a subsequent annual report.

The second part of this experiment was designed to confirm our previous reports that the SMV G-2 severe strain induced male sterility in Williams soybeans. A measure of the degree of outcrossing was not included as a part of the former experiments and so it is included here as a further confirmation of results.

Cumberland soybean seeds were planted as previously described in this report. Williams soybean seeds were hand-planted in 10-foot sections within the Cumberland rows. As in the first part, the seedlings with purple hypocotyls (Cumberland) were removed from these 10-foot sections. The experiment was planted in a completely randomized design with three treatments and 20 replications, with each treatment adequately separated to minimize interplot interference. The three treatments were:

(1) Uninoculated Williams ms-2, a genetic male-sterile variety. This was included to determine the natural rate of outcrossing in the field.

(2) Williams inoculated with SMV G-2 severe strain. This was used to determine the rate of outcrossing due to virus-induced male sterility. Seedlings were inoculated 10 days after planting with an artist's airbrush. After 1 week all uninfected plants were removed.

(3) Uninoculated Williams, included as a control. Yield data were taken to compare with that from our previous year's experiments. During the winter of 1983, 100 seeds from each plot will be planted in greenhouse sandbenches. Data will be recorded with the most important being the degree of outcrossing, as indicated by the percentage of plants with purple hypocotyl color. Results will be reported in next year's annual report.

Identification of Soybean Viruses from the People's Republic of China. Thirty samples of soybeans with virus-like symptoms were collected from several locations in the People's Republic of China. Samples were dried, transported to Illinois, and mechanically inoculated to soybeans. Twenty-one isolates were obtained. The identities of the virus isolates were determined by serology, symptomatology, and host range. Sixteen isolates were identified as soybean mosaic virus, one as tobacco ringspot virus (TRSV), one as southern bean mosaic virus (SBMV), and three as double infections of SMV and SBMV.

An analysis of the strains of SMV was conducted using the soybean differentials developed here previously and three other lines (PI 96983, Suweon 97, and SS741185) which were resistant to all previous strains of SMV. All isolates infected the differentials in various known patterns (see Table 16), but more importantly, five infected one or more of the supposed resistant lines, causing mosaic or necrosis. Three isolates caused necrosis in Suweon 97, three caused mosaic in PI 96983, and one caused mosaic in PI 96983 and necrosis in Suweon 97 (Table 16).

These results are important for several reasons. It is the first time that SBMV and TRSV have been reported from China. The potential of damage due to these viruses in China is unknown. Second, the experiments demonstrated the usefulness of the soybean differential lines for the evaluation of unknown SMV isolates. Third, the finding that isolates of SMV from China infect soybean lines previously believed resistant to all strains of the virus will affect the use of these cultivars in breeding and in commercial planting. For example, Suweon 97 was recommended for use in 1981 in Korea. The release of a supposed SMV-resistant line which is in fact susceptible to as yet unidentified strains of the virus could result in severe infections and low yields. These findings support the concept that there is a significant variability in the pathogenicity of SMV strains and that these strains are highly unstable. Such conclusions have important implications for a breeding program for the development of resistant lines.

Machismo Disease of Soybeans. Machismo disease of soybeans, first reported in the Cauca Valley of Colombia in 1968, increased dramatically each year until in 1979 some fields had infection rates up to 80 percent and yield losses reached 1,600 kg/ha. The infected plants were characterized by a deep green color, proliferation of branches at lateral nodes, phyllody of flowers, germination of immature beans within pods, and upturned pods. The disease is believed to be caused by a mollicute or mycoplasma-like organism. Transmissible neither by mechanical means nor by seed, the only known vector of machismo is the leafhopper, *Scaphytopius fuliginosus*. Several countries in South America (including Peru and Mexico), Africa, and Asia are plagued by a similar disease. In Louisiana, "Q disease" of soybeans also has similar symptoms and is leafhopper transmitted.

A project was initiated in October of 1982 to study machismo disease. Goals were, first, to search for and collect soybean plants from Mexico showing machismo-like symptoms. These would be transported to the University of Illinois at Urbana-Champaign (UIUC) under USDA-APHIS quarantine restrictions for continued study until spring 1983. Second, to compare the

Table 16. Reaction on Differentials of SMV Isolates from China by Strain and Location

Strain	Origin	ID No.	Differentials								
			W	Y	M	O	K	B	PI	S97	SS
G1	Jilin	6	M	--	--	--	--	--	--	--	--
	Jilin	8	M	--	--	--	--	--			
	Shanghai	30	M	--	--	--	--	--	--	--	--
	Jilin	4	M	--	--	--	--	--	--	--	--
G2	Hubei	18	M	--	N	--	--	--			
	Hubei	21	M	--	M	--	--	--			
	Hubei	23	M	--	M	--	--	--			
	Liaoning	11	M	--	M	--	--	--	--	--	--
G3	Hubei	17	M	--	N	N	--	--			
	Hubei	20	M	--	M	M	--	--	--	--	--
G4	Jilin	7	--	--	--	--	--	--			
G5	Beijing	15	M	M	--	--	N	--	--	--	--
G6	Sandong	25	M	N	M	--	N	--	--	--	--
G7	Sandong	26	M	M	M	M	N	M	M	--	--
?(G7?)	Sandong	24	M	M	M	--	N	M	M	--	--
G8	Liaoning	13	M	M	--	--	N	--	--	N	--
	Beijing	14	M	M	--	--	N	--	--	N	--
	Biejing	16	M	M	--	--	N	--	--	N	--
G10	Sandong	28	M	M	M	M	M	N	M	N	--
G9	Beijing	Sb	M	M	M	M	--	N	M	--	--
G3	Beijing	Sc	M	--	N	N	--	--	--	--	--
G1	Beijing	Sd	M	--	--	--	--	--			
G1	Beijing	Sf	M	--	--	--	--	--			

Mexican disease with the known machismo disease from Colombia (plants of the latter having been collected and transported to the UIUC by M. E. Irwin). If shown to be identical, the known geographical range of the disease will have been significantly extended. Third, to develop a rapid and accurate assay for the detection of the pathogen in diseased plants and insects by producing an antiserum in rabbits and developing enzyme-linked immunosorbent assay (ELISA) or Ouchterlony double diffusion techniques. Important applications of this assay would be for positive diagnosis of machismo in the field and in both host plants and suspected vector species, determination of weed reservoirs, and comparison of this pathogen with agents of other diseases. Fourth, to increase basic knowledge from which plans may be made for a long-range study of the ecology, epidemiology, and control of the disease. Ultimate control will depend on the ability to assay for the pathogen, as mentioned above, and knowledge of pathogen ecology. Control will include aspects such as breeding programs to develop disease resistance, cultural practices, and insect management procedures.

Soybean plants with machismo-like symptoms were collected from an experimental INIA plot of soybean cultivar UFV-1 at the Rosaria Izita substation

of the Tapachula Experiment Station in extreme southwestern Mexico. Though the incidence in this field was low (less than 0.5 percent), local experiment station scientists reported seeing the disease in other fields and in previous years. A sweep of the field for insects resulted in the colletion of numerous leafhoppers, a majority of which were species of *Scaphytopius*. M. E. Irwin, who travelled on to Colombia, collected plant with machismo symptoms and brought them back to UIUC.

Preliminary tissue sectioning for Deines' staining (specific for the presence of mycoplasma-like organisms in diseased tissue) gave positive results in plants from both countries. Initial attempts to isolate a pathogen from the Colombian plants using standard methods and media for *Spiroplasma citri* were negative. The procedure will be repeated with the same media and with media for the corn stunt spiroplasma. Sections of tissue of both Colombian and Mexican plants have been fixed for examination by electron microscopy.

Although quarantine restrictions prohibit our use of insect vectors, we must transmit the disease to healthy seedlings to achieve the amounts of tissue required for further isolation and purification efforts. Therefore, the following methods are currently being tried to accomplish transmission: (1) Grafting--physiologically young tissue from infected plants was grafted onto healthy 7-day-old Williams soybean seedlings. The graft was encased in a 1.5-cm length of plastic straw. Grafted seedlings were placed in the quarantined growth chamber. (2) Dodder--seeds of this parasitic plant were soaked for 2 days prior to planting. On germination, the young dodder shoots were trained onto healthy cucumber seedlings to establish the parasitic state. These will later be transferred onto the Mexico- or Colombia-collected soybeans and then onto healthy young Williams or periwinkle seedlings for transmission of the disease agent.

If transmission tests are successful we will continue to compare the diseases from Mexico and Colombia and attempt to develop a serological assay.

Mycoplasma-like pathogens cause serious, debilitating, and yield-reducing diseases in numerous plant hosts. Their known host ranges and geographical limitations are quickly expanding. Yet, very little is known about their epidemiology or their potential for destructiveness. Severe epidemics of machismo in certain years in Colombia indicate the threat of this pathogen. This study will provide a basis for continued monitoring of the disease in Colombia and elsewhere. Additional results will be presented in the 1983 annual report.

Intsoy/IITA Project to Produce Tropical Soybean Germplasm Accessions Resistant to Virus and Mycoplasm Diseases. In October, 1980, 339 lines of soybeans were sent to Colombia for testing for resistance to machismo disease. These were planted in 1981 but the disease was of insufficient severity that year to evaluate the lines.

Development and Testing of New Methods for Sensitive Detection of Whitefly-Borne Geminiviruses. Continuing research on the whitefly-transmitted

yellow mosaic diseases of the New World tropics made important progress in 1982. We were able to obtain direct evidence that gemniviruses related to bean golden mosaic virus (BGMV) caused a number of whitefly-transmissible yellow mosaic diseases in Puerto Rico, including several in soybeans. This had long been suspected on the basis of extensive indirect evidence from symptom, host range, and vector transmission studies by Julio Bird and others in Puerto Rico and other parts of the New World tropics. Our approach was to examine tissue from yellow mosaic-diseased plants for the presence of DNA sequences genetically related to the genome of BGMV. The methods we have developed should find wide application in the definitive, rapid, and sensitive diagnosis of geminiviruses directly from field materials.

Our laboratory studies of BGMV indicated that it had a genome of two components of single-stranded circular DNA which replicated in infected plant cells via double-stranded (ds) DNA intermediates. If other whitefly-transmissible yellow mosaic diseases of Puerto Rico and elsewhere were caused by geminiviruses related to BGMV, then the infected plant tissues should contain small amounts of dsDNA genetically related to the dsDNA intermediate of BGMV DNA replication. Very small amounts of any DNA sequence can be specifically detected even in the presence of much larger amounts of "contaminating" DNA by its hybridization to a defined radiolabelled DNA probe. In our case this meant obtaining preparations of total low molecular weight DNA from infected plant tissues and detecting geminivirus sequences by hybridization with radiolabelled probes made from either DNA from purified BGMV particles or from cloned BGMV DNA. Since the plant diseases caused by geminiviruses occur predominantly in tropical countries where laboratory facilities are limited, we have aimed at developing methods based on the above approach which are simple so that as much as possible can be done on site quickly.

The tissue from which the low molecular weight DNA (containing the suspected geminivirus DNA sequences) is to be obtained should be young leaves but may be collected directly from the field. If it is to be processed soon it can simply be refrigerated or (preferably) frozen. If it is to be shipped it can be dried over calcium chloride or lyophilized. The tissue (dried or frozen) is pulverized in liquid nitrogen to break up the cells. After extracting proteinaceous compounds with a mixture of phenol and chloroform, the nucleic acids which are in the aqueous phase are precipitated with ethanol. Several cycles of ethanol precipitation and aquaeous resuspension follow to partially purify the preparation and reduce its volume. This procedure for obtaining a crude nucleic acid preparation can be carried out with simple facilities and the nucleic acid in ethanol can be easily stored or shipped.

Much of the host nucleic acid and all RNA is removed by density gradient centrifugations, leaving a preparation of low molecular weight DNA suitable for restriction analysis. Restriction with enzymes generates diagnostically useful patterns of specific fragments when the restriction fragments are separated by agarose gel electrophoresis, fixed onto nitrocellulose paper and tested for hybridization with radiolabelled probe made from BGMV DNA.

A method which yields diagnostic patterns of fragments specific to geminivirus genomes using gram amounts of field tissue, without any need to propagate and purify virus particles, is clearly a powerful tool. In a short time we were able to establish that the agents of "mosaico dorado" (BGMV), *Euphorbia* mosaic, *Rhynchosia* mosaic, *Boerhavea* mosaic, *Jatropha* mosaic, *Merremia* mosaic, and *Sida* mosaic are related but distinct geminiviruses, confirming the early insight of Bird and others. Quite unexpectedly, this approach also revealed that the whitefly-transmissible agent of a yellow mosaic in *Malvastrum coromandelianum* and BGMV are identical. This is a major finding because the host range of BGMV was previously believed to be restricted to a few legumes. *M. coromandelianum* is a perennial malvaceous weed and thus very possibly a natural reservoir of inoculum for the often devastating BGMV on beans. The application of this approach to geminivirus diagnosis would not have been possible if one member, BGMV, had not been "domesticated" for laboratory study and much basic knowledge been gained about it. Thus one of the most gratifying outcomes of these studies has been to confirm the generality of the BGMV model for (at least some) whitefly-transmitted geminiviruses: a genome consisting of two DNA components nearly identical in size (2600 bases) and largely dissimilar in sequence.

Purification of Two-Gemini-Like Viruses Infecting Soybean. Work was begun in March 1982 to purify several gemini-like viruses which infect soybean and are found in Puerto Rico. These viruses are difficult to work with. They are generally not mechanically transmissible, are found naturally in weeds which contain latex and other substances which complicate working with them, are unstable at standard temperatures, and are transmitted by *Bemisia tabaci* (a tropical whitefly). Geminiviruses generally cause a yellow mosaic in the infected plants, and are the suspected cause of several soybean and many non-soybean diseases in the tropics. Purification of these agents permits the development of serological assays for detection of the viruses and also permits the comparison of the age with those of other diseases, leading to a better understanding of the viruses and diseases.

Two agents were studied: the cause of *Rhynchosia* mosaic (RM) and the cause of *Euphorbia* mosaic (EM), both of which cause a yellow mosaic in soybean but which have different host ranges. These are probably two different viruses, but this will not be known for sure until they are purified.

This research will continue through the first half of 1983. To date the following has been accomplished. A mechanically transmissible isolate of RM has been selected and sufficient quantities of infected tissue have been produced for purification, which will begin shortly. A mechanically transmitted isolate of EM has also been selected and attempts at purification have already begun. Because geminiviruses are so unstable, a very gentle process of mincing the tissues and immediately layering it on a sucrose gradient has been attempted; however, the virus has not been recovered. Other methods, including the process developed for bean golden mosaic virus, will be continued this year.

Conclusion About Viology Related Activities. Virology research in INTSOY continues to contribute to soybean production improvement in

developing countries. The system for SMV strain classification has been adapted by virologists worldwide, and our collections of both virus strains and antisera remain available to fill requests from other nations. We continue to work toward the production of disease-resistant soybean lines by studying factors which affect breeding programs. These areas of study include aspects ranging from virus seed transmission to virus-induced male sterility for the purpose of encouraging outcrossing. The virology program assists in annual and one-time training courses both in Champaign-Urbana and in developing nations. We provide support work for other INTOSY researchers, as in the production of antiserum against *Rhizobium* strains for the microbiology program in Puerto Rico. Virology at the University of Illinois and INTSOY has attracted both students and visiting scientists from many nations. During the past year, Mr. Narceo Bajet has almost completed the requirements for the Ph.D. degree and will soon return to the Philippines to work in agricultural research. Two visiting scientists, Dr. Y. L. Nene, from ICRISAT, India, and Mr. Xu Zhigagn, from Nanjing Agricultural College, People's Republic of China, provided a stimulating and rewarding interchange of knowledge, customs, traditions, and good will. Other students in the group, though not affiliated with INTSOY, are from Korea, India, and Canada. We continue to exchange communications with former INTSOY students Dr. Pornpod Thongmeearkom (1975-1978, Thailand), Dr. G. R. Bowers, Jr. (1976-1980, Beaumont, Texas), and Dr. E. K. Cho (1977-1981, Korea) as our network of colleagues grows.

Monitoring and Predicting Vector Spread and Developing Effective Control Measures. We published an article on soybean mosaic virus that addresses the pathogen-vector complex, dynamics of spread, management of epidemics, and methods in soybean mosaic virus research in English, Spanish, and French in the FAO Plant Protection Bulletin 29:41-55. This article focused on controlling a nonpersistently transmitted plant pathogenic virus by using the concepts of integrated crop protection. The article outlines ways to resolve a complex problem in a developing country with a minimum of sophisticated equipment and expertise.

Cooperative Studies on the Epidemiology of Soybean Mosaic Virus. Soybean scientists from four southern states cooperted in an experiment to study and predict SMV epidemiology. The purposes of the cooperative experiment were: to determine tolerable rates of initial SMV seed transmission under different regimes; to validate and improve an existing model that predicts seed transmission rates and yield parameters based on initial inoculum levels and aphid flight timings and abundances (our model was developed by W. G. Ruesink based solely on data from Illinois); to generate computer simulated economic injury levels of SMV based on a validated computer model of the system; and to test out the experiment nationally before attempting to initiate such a trial on an international basis.

Scientists from the following states cooperated: Georgia, Louisiana, Mississippi, and Virginia. The same seed (cv. Essex), virus isolate (SMV-G5), and experimental design were used in each state. The virus incidence was monitored weekly, giving movement pattern relative to plant phenology.

One plot at each site was inoculated at a 2.5% level (every 40th plant sap inoculated) while the other plot was not inoculated (Figure 1). Aphids were captured in both plots with the horizontal mosaic green traps we had earlier developed. Aphids were taken from the traps daily.

Although not all results have been received yet, our own plots in Illinois were compared with equal plots of cv. Williams, a cultivar that is well adapted to central Illinois. The spread pattern of SMV in both the 2.5% initial inoculum plots of cvs. Williams and Essex are similar but the contamination spread through the Essex and Williams 0% plot were quite different (Figure 2). The delay in cv. Williams 0% over that of cv. Essex 0% was due to the Essex 0% plot being adjacent to a 2.5% plot while the cv. Williams 0% plot was adjacent to the Essex 0% plot.

The Mississippi data suggested that the yield for the 2.5% Essex plot was about 35% less than that for the 0% plot, but that yield in the 0% plot at Georgia was only about 3 percent greater than the 2.5% plot. Data are incomplete, but analyses will test the already operative epidemiology model.

Since one objective of this experiment is to determine tolerable rates of seed transmission of SMV under different regimes (especially aphid flight regimes), it is necessary to repeat this for at least two and probably three years. The idea is to use the seed from the 2.5% initially infected plot the second year. Controls will be an initially healthy plot and an initially 2.5% infected plot. The third year will add an additional treatment, the seed from year 2 initially 2.5% infected plot. This can be expressed through this illustration.

YEAR 1	YEAR 2	YEAR 3
No Initial Infection	No Initial Infection	No Initial Infection
2.5% Initial Infection	2.5% Initial Infection	2.5% Initial Infection
	Seed from year 1 2.5% initial infection	Seed from year 2 2.5% initial infection
		Year 2 seed from year 1 2.5% initial infection

Aphid Transmission Rates of SMV and Their Virus/Vector Relationships. We are developing a laboratory method for testing behavioral responses of different aphid species as they relate to the transmission of plant viruses.

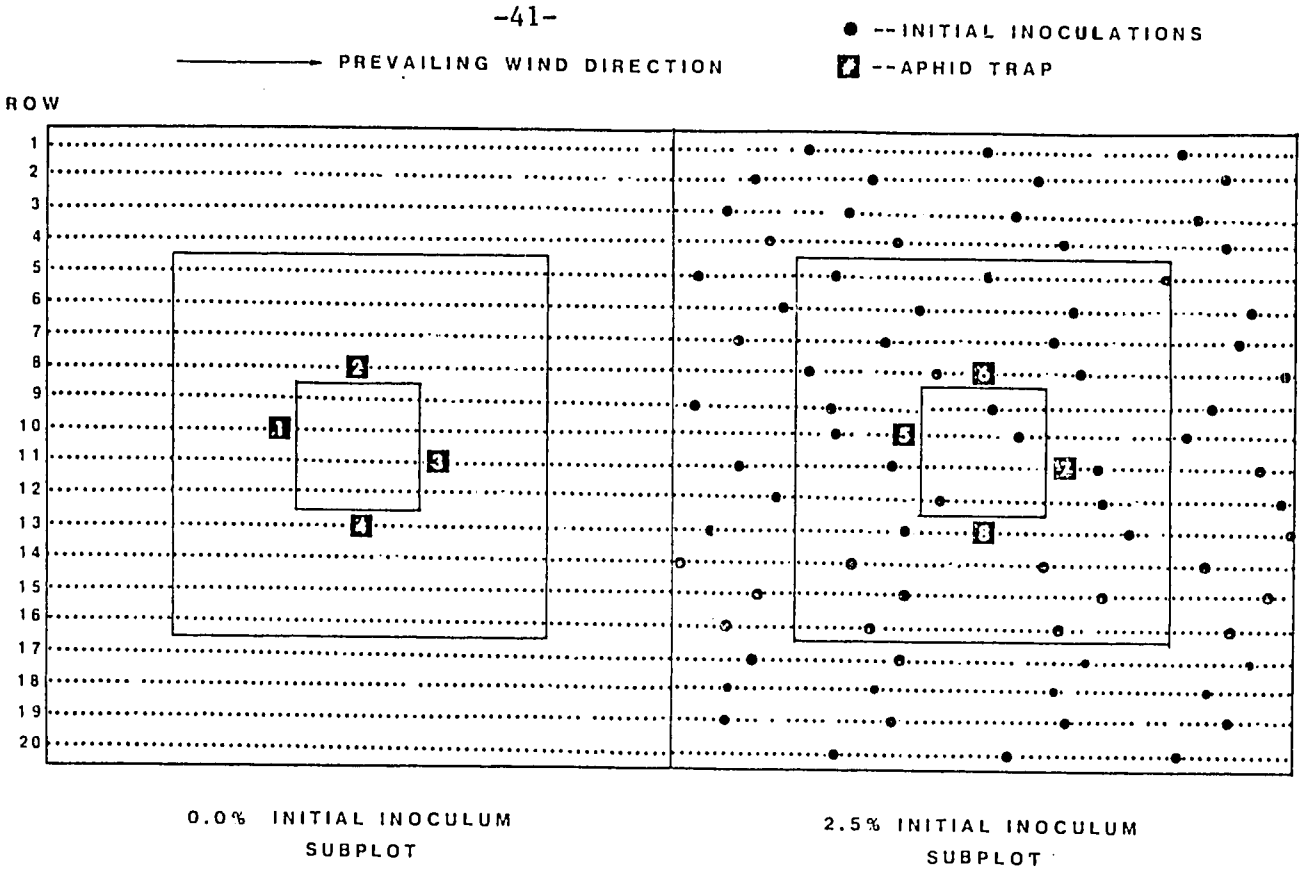


FIGURE 1

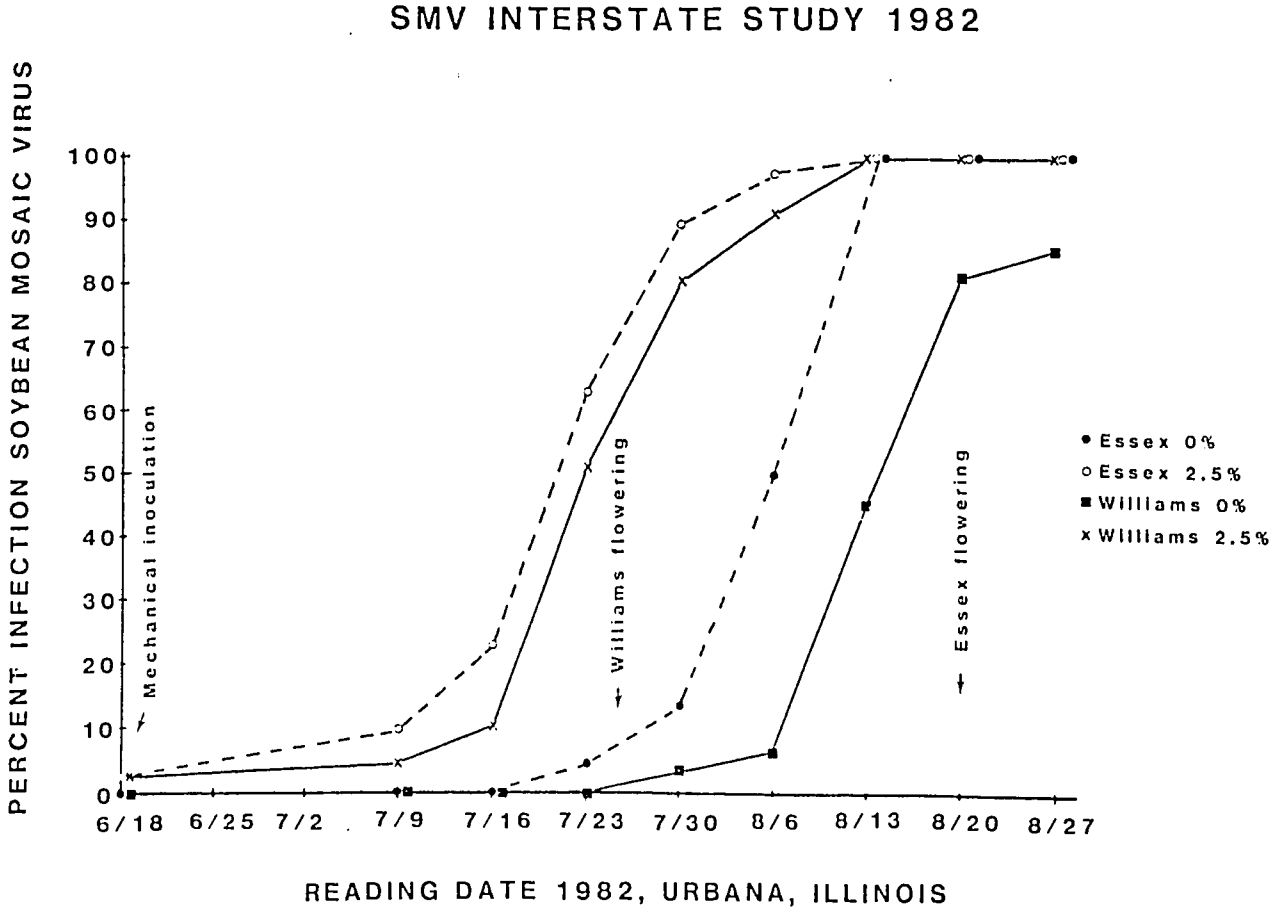


FIGURE 2

Soybean mosaic virus (SMV), our model system, is transmitted in soybean fields by transient alate aphids in a nonpersistent manner. The spread of the virus depends on species, timing, and abundance of aphids landings in the field. In the past, methods for discovering and assessing aphid vectors of SMV have included live trapping. As part of her Ph.D. research, Dr. Susan Halbert picked alighting aphids from a net placed downwind of an infected soybean field. This method has the distinct advantage of relating directly to a field situation and the disadvantage of being restricted to aphid species landing on the net and being very time consuming relative to the numbers of aphids tested.

Laboratory methods used to date have included both acquisition access and acquisition feeding approaches. The acquisition access method involves placing prestarved aphids on a source plant and allowing them to probe or not at will for a specified amount of time (usually 1-10 minutes). This method is quick, easy, and large numbers of aphids can be processed in a relatively short period of time. The information gained in such a test is limited to stating whether transmission was achieved.

The second of the laboratory methods used to date involves timed acquisition feeding probes where the experimenter sits and watches a prestarved aphid probe for usually 15-30 seconds on an infected source plant. This method has the advantage of insuring that all aphids have actually settled with the probosis perpendicular to the substrate thus providing more uniformity in the measurement of transmission frequency. It is very time consuming, however, and often less than 100 aphids can be tested in a single day by a researcher.

The method we are developing is a refinement of the first laboratory method and shares its ease of execution. As with the other two laboratory methods, we first starve aphids in jars for at least one hour, taking a predetermined size and morph. Source plants have been mechanically inoculated 14 days previously when the plants were at the primary leaf stage then kept in a growth chamber at 24°C. They are reduced to one trifoliolate, usually the first, and put in a test tube containing 1 to 1 1/2 mls of tap water. The stem is immobilized with parafilm. Each test tubed source plant is then sunk into the center of an 8" pot containing eight test plants at the primary leaf stage arranged in a ring. Aphids are placed by brush on the source and a plexiglass cylinder is fit over each arena and left for 24 hours. The next day the cylinders are removed and the plants either fumigated or sprayed with Pirimore®, an aphidicide. Symptoms appear after 6 or 7 days, at which time the plants can be visually evaluated. In 10 days an ELISA can be run to check the visual readings for accuracy.

We have compared the arena test to timed probes in an experiment using normal dark green and chlorophyll-deficient (yellow) isolines of Clark soybean (Table 17).

Table 17. Effect of Isolines of Clark Soybean on Aphid Transmission of Soybean Mosaic Virus (SMV)

Test: color	No. infections/ total no. plants	x[a]	Percent SMV
Observed probes:			
Yellow	40/80	4.0	50.0
Green	33/80	3.3	41.3
Arena:			
Yellow	67/80	6.7	83.8
Green	72/80	7.2	90.0

[a]Average no. infections per 8 plants.

Although the number of infections in the arena were nearly twice that of the observed probes, our interest lay in determining whether either method would show a significant difference in infection rate of either the yellow or green soybean. Neither method shows a significant difference between the green or yellow colors. The difference in the amount of time spent at each method was significant, however. Completing the 160 timed probes of *Myzus persicae* took a team of people all day whereas, done all at once, the arenas could have been set up in less than 1/2 hour.

We have also used *Myzus persicae* in the arena test to compare relative transmissibility of two strains of the virus, SMV-G5 and SMV-G2. A total of 192 apterous aphids were tested in a completely random design (Table 18). There are no significant differences in the transmissibility of either strain.

Table 18. Arena Method for Comparing Aphid Transmission of Soybean Mosaic Virus (SMV) Strains

Strain	Infections	Total plants	% SMV
SMV-G5	66	96	68.8
SMV-G2	68	96	70.8

Another use to which we have put the arena has been in the screening for potential virus vectors. Because of the large numbers of aphids that can be tested in a short period of time, even relatively poor vectors can be detected. Early last summer we set up a small test to see if *Capitophorus hippophaes*, a species frequently encountered in our pan trap catches, would transmit SMV. We tested 10 arenas with 8 aphids per pot and got no transmission. A subsequent attempt at timed probes by only 16 aphids also failed because of the difficulty in getting them to probe on soybean, a nonhost. Recently, we tried again by testing 20 aphids per pot totalling 340 aptery in 17 arenas for each of two Illinois colonies of *C. hippophaes*, one from Champaign-Urbana, the other from Chicago. Out of 680 aphids tested, we got 4 transmissions--3 in the C-U colony and 1 from the Chicago colony--from a total of 272 plants (Table 19). Barring multiple infections

of those 4 plants, which seems highly unlikely since each infected plant came from a different arena, the transmission rate for *C. hippophaes* is only 6/1000. This is the first report of successful transmission of SMV by this species. However, to detect a transmission rate this low by timed probes is an onerous task at best, and given that *C. hippophaes* resists probing, it might not be detected even in the acquisition access method described earlier.

Table 19. Arena Test for Detecting Low Level Transmission in Capitophorus hippophaes

Colony tested	Number of arenas	Number of aphids/arena	No. infections/ total no. plants
Champaign-Urbana	17	20	3/136
Chicago	17	20	1/136

One lure of this method is to attempt to compare transmission frequency of different species of aphids using the same strain of the virus.

We ran two tests on separate occasions looking at 9 different species, six of which are presented here (Table 20). *R. maidis* did well in the first test but not the second, but for *A. citricola* and *A. nerii* the converse was true. Others were more consistent. It should be emphasized that the comparison we are dealing with in this table is a horizontal one between tests and not vertical between species. That *R. Padi* transmits relatively poorly and *M. persicae* so well maybe due to the environmental conditions under which the experiment is conducted. The horizontal variations between tests do raise an interesting question though as to what sorts of factors could contribute to such a phenomenon. We suspect that at least part of the variation can be accounted for by the physiological state of the aphids such as the greater use of baby laden adults vs. late instar nymphs in one test than the other. The arena test is ideally suited to looking at how mobility of an instar affects transmission rate and might be coupled with timed probes to confirm that these differences are not inherent in the ability of a particular instar to transmit.

Table 20. Variations in Soybean Mosaic Virus Transmission by Aphids Using the Arena Method

Species	Percent transmission[a] Test 1	Test 2
Rhopalosiphum padi	2	0
R. maidis	10	32*
Aphis citricola	38	15*
A. craccivora	42	42
A. nerii	58	12*
Myzus persicae	90	98

[a]Number of infected plants out of 40 for each test.
*Significant difference between tests at the 5% level.

Another surprise to us when we looked at the results of the first test was the high transmission rate of *Aphis nerii*. We had once assumed it to be unimportant based on data from timed probes where it was very difficult to get it to probe on soybean. The arena shows it can have a significant impact and needs to be looked at further.

The advantages of this system are clear: 1) large numbers of individuals can be tested in a relatively short period of time, making it a good method for the screening of potential vectors and 2) the arena is analogous to a field situation where aphids can move at will from the infected plant to healthy test plants, the 24 hour time span making it more likely that reticent probers will actually probe and have a chance to transmit. The constraints on this test include the possibility of multiple infections of the same plant and serial transmission by the same aphid to more than one plant in the arena.

Bearing this in mind, the method can be used to look at the transmission frequency of different instars or aphid morphs. Different virus isolates or strains can be screened for aphid transmissibility and a change in the transmission frequency can be detected over time. Plant cultivars can also be tested, with an eye to screening for host plant resistance. One can examine how time of day influences infection rates of the effects of insecticide application on transmission. The arena is also uniquely suited to studying the effect of temperature on transmission because it can be quickly set up in a growth chamber. And of course the method can be modified to accomodate other virus systems.

Development of Sampling Metnodology and Monitoring Systems for Soybean Pests, Insect Vectors of Soybean Pathogens, and Natural Enemies.

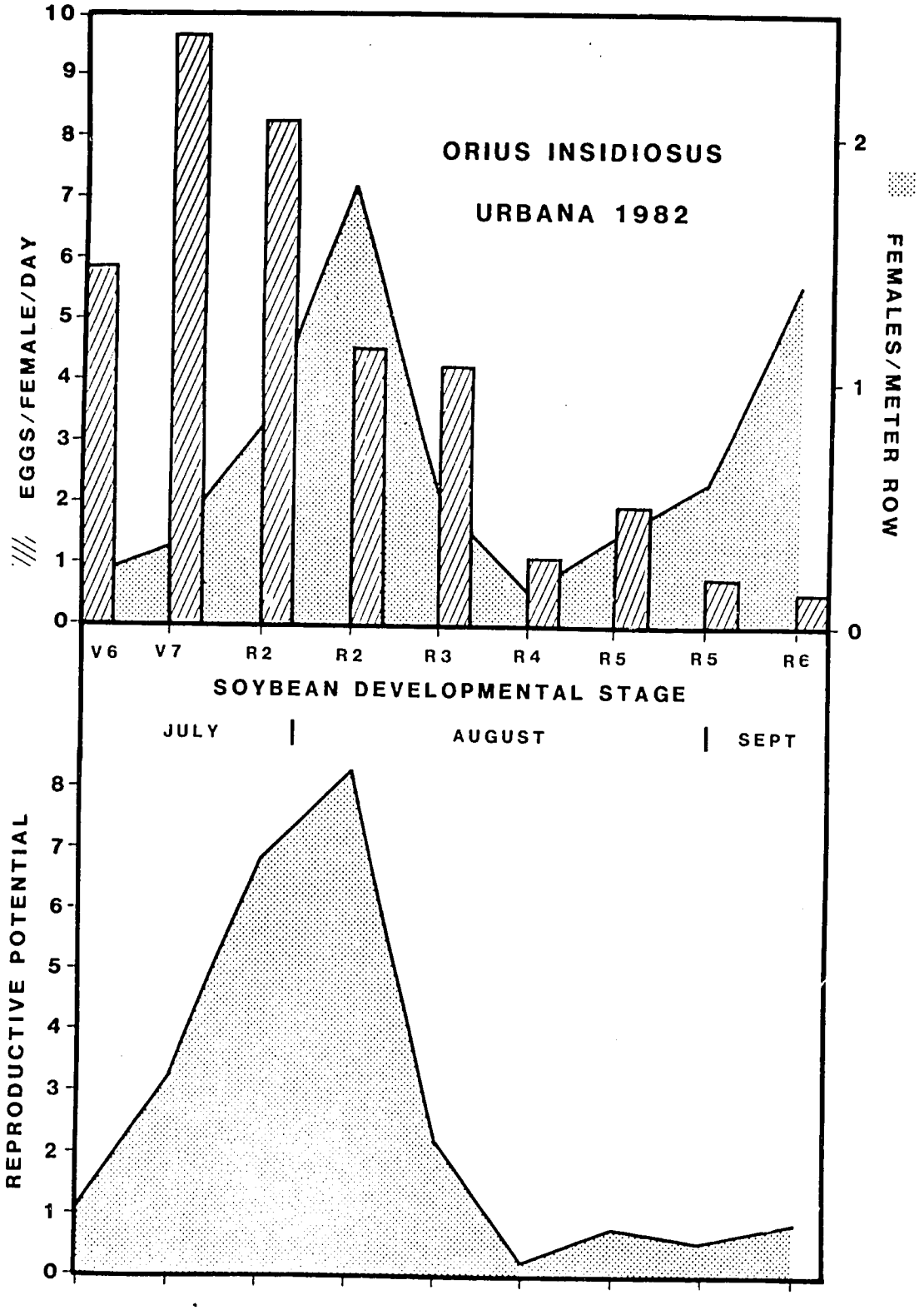
Orius insidiosus. An experiment was conducted to determine the reproductive potential of *Orius insidiosis* in soybeans throughout the 1982 season. *O. insidiosis* is a predator with a wide host range and is by far the most common natural enemy found in soybean fields in Illinois. It is also very common throughout Latin America.

Weekly beat-cloth samples were taken in a soybean field in Urbana, IL. All adults were aspirated from the cloth and brought back to the laboratory for sexing. A sample of no more than 20 females was then taken from each group and isolated for three days with adequate food and water and a fresh greenbean as an oviposition substrate.

An estimate of reproductive potential could be gained from this information. The largest number of eggs were laid by females at the beginning of the season when the fewest number of adults were in the field (Figure 3). Female *O. insidiosus* peaked during flowering (R2), while fecundity was declining (Figure 3). Increased numbers of *O. insidiosus*, including females, were collected during the time when soybeans were maturing, but female fecundity was low (Figure 3). Females from this late generation overwinter.

Reproductive potential was highest during early flowering and declined rapidly after growth stage R3 (Figure 4).

Aphids as vectors of soybean mosaic virus. In 1980, Dr. David Ferro of the University of Massachusetts inquired about our aphid traps for his work on virus epidemiology in peppers and potatoes. After considerable discussion, he devised his own traps based on our concepts of trap design. Instead of using green ceramic tiles, he used clear petri dishes and painted the underside green. In 1982, we decided to compare the two trap designs under similar field conditions in Illinois and Massachusetts. Although the trap catches have not been analyzed, it is clear that our trap design caught about 10 times more aphids than did Ferro's. The reasons for this difference are not known and we hope to jointly develop experiments in 1983 that will elucidate the factors resulting in such differing catches.


ORIUS INSIDIOSUS
URBANA 1982
EGGS/FEMALE/DAY
FEMALES/METER ROW
V6
V7
R2
R2
R3
R4
R5
R5
R6
SOYBEAN DEVELOPMENTAL STAGE
JULY
AUGUST
SEPT
REPRODUCTIVE POTENTIAL

DEVELOPMENT OF SOYBEAN INSECT PEST MANAGEMENT SYSTEMS

Research in this area focused on important component areas of effective insect management systems. Some of the research was conducted at the UIUC and other activities took place in Peru.

Influence of Wind on the Flight Direction of Parasitic Hymenoptera. Various factors, particularly wind drift, decrease the effectiveness of chemical insecticide applications. With the introduction of inundative releases of parasitoids as biological control agents, it is important to know if these releases are affected by wind in an analgous manner. This study begins to address this question by examining the influence of wind on parasitoids naturally occurring in the field.

Parasitoid dispersal was monitored by means of one fixed and one wind-directed sticky trap maintained at canopy height in a field of soybean cv. Williams between June 1 and October 3 on the South Farms at the University of Illinois at Urbana-Champaign. The traps were clear plastic cylinders 20.5 cm in diameter and 26 cm tall. The surface of each cylinder was covered with a sheet of Saran Wrap® coated with Tanglefoot® and was changed twice a week. The sheets were cut into four quadrats which were then soaked in acetone to dissolve the Tanglefoot. The insects were filtered off and stored in alcohol prior to sorting. The quadrats of the fixed trap were centered to the North, South, East, and West, and the quadrats of the wind vane trap were centered to windward, 90° windward, leeward, and 2.70° windward.

The number of individuals of the Ichneumoidea caught on the windward, average of the two crosswinds, and the leeward quadrats, and the ratio of wasps flying downwind to upwind are shown in Table 21. An asterick after the name indicates a non-random distribution on the basis of χ^2 test and assumed ratio 1:1:1 ratio. There was a random distribution of the Ichneumonidea and a strong downwind dispersing tendency of the braconids and aphidiids.

Table 21. Wind Vane Trap: Number of Individuals of Ichneumonidea on Each Quadrat

Family	Windward	Crosswind (Average of 90° & 270° quadrats)	Leeward	#Windward/#Leeward
Ichneumonidea	6	7	10	.60 (1/1.67)
Braconidae*	146	40.5	11	13.30
Aphidiidae*	11	4	0	11.00

The Chalcioidea show a general downwind trend which is especially strong in the Mymaridae and Trichogrammatidae. The encyrtids, however, are a curious exception to this general pattern, showing a tendency to disperse upwind (Table 22).

Table 22. Wind Vane Trap: Number of Individuals of Chalcioidea on Each Quadrat

Family	Windward	Crosswind	Leeward	#Windward/#Leeward
Pteromalidae*	26	12	10	2.60
Eulophidae*	51	16	9	5.67
Encyrtidae*	62	24.5	104	.596 (1/1.68)
Mymaridae*	242	38	9	26.90
Trichogrammatidae*	138	26.5	21	6.57

The Proctotrupoidea and Ceraphronoidea also show a strong tendency to disperse downwind but the Cynipoidea are once again exceptions to the general trend (Table 23).

Table 23. Wind Vane Trap: Proctotrupoidea, Ceraphronoidea, Cynipoidea,

Family	Windward	Crosswind	Leeward	#Windward #Leeward
Proctotrupoidea				
Scelionidae*	122	34	13	9.38
Platygastridae*	81	29	24	3.38
Ceraphronoidea*	203	39.5	13	15.60
Cynipoidea* (Eicpolodae)	108	128	168	.643 (1/1.55)
Totals*	1,197	402	392	3.05

Ten of the eleven taxa studies show wind-related dispersal tendencies so wind has an important affect on the direction of dispersal of parasitic Hymenoptera. Three taxa appear exceptional showing either random or upwind dispersal tendencies.

In Juillet's study of the flight behavior of parasitoid wasps, he found that flight activity in ichneumonids is inversely related to wind speed and the largest numbers were collected in the morning and evening when wind speeds were lowest. Ichneumonids then are not affected by wind due to temporal avoidance and probably their large size gives them stronger flying ability.

Almost all the encyrtids collected belonged to the genus *Capidosoma*, and 26% of the individuals on the windward quadrat were male while 78% of those on the leeward quadrat were male. The distribution of the encyrtids can be explained by the superposition of an upwind dispersal by males, possibly searching for or following female pheromone trails over the normal downwind dispersal pattern for parasitoids.

The Cynipoidea are not easily explained. Both upwind and downwind dispersing wasps are 85 to 90% female. They may avoid wind by activity periods early or late in the day like the ichneumonids.

In summary, the tendency of parasitic wasps to disperse downwind parallels the behavior of many other groups of insects and it is very important for the dispersal behavior of a parasitoid to parallel that of its host.

McClure in his 1977 found that two species of aphelinid parasites caught on sticky traps were blowing along with the dispersal stage of their diaspid scale host. Many other pests have also been shown to disperse downwind.

Downwind dispersal of parasitic wasps is significant and especially so in the braconids, mymarids, and trichogrammatids which are often used in inundative releases. Attention needs to be paid to weather conditions, particularly wind speed, for planning both the timing and location of an inundative release.

Determine the Effect of Various Cropping Practices on the Population Dynamics of Important Soybean Insect Pests and on the Epidemiology of Important Soybean Viruses.

Effect of Ground Cover on Aphids: Controversy surrounds the concept that aphid vectors are attracted to areas of less ground cover. To assess this problem in the past, we have looked at different row spacing and at different planting dates. During the 1982 season we addressed both in a single experiment with the idea of looking for interactions between the two treatment types. The results have not been analyzed yet.

Development of Cultural, Behavioral, Biological, and Chemical Methods for Controlling Pests by the Peru National Program: A pilot insect pest management program for soybean in the upper selva zone of Peru was initiated in 1979. It was discussed in IPR-81-1. Recent developments in that project include the following:

Planting Date. The effect of soybean planting date on the population buildup and level of *Anticarsia gemmatalis*, *Cerotoma arcuata*, and *Piezodorus guildinii* in the Tarapota area of Peru was studied. The objective of the experiment is to determine the most favorable planting date for soybean production from the standpoint of the above mentioned key pest species of the region.

Insect Resistance. Screen the available germplasm for resistance or tolerance traits to *Cerotoma arcuata*, *Piezodorus guildinii*, and *Pseudoplusia includens* in the Bagua area of Peru. The objective is to determine the degree of resistance local germplasm has to key pests of the Bagua-Jaen zone.

Plan for 1984. Develop a plan through 1984 for the advancement of Phase IV of the project that deals with lowering population levels of key pests in the various regions by tactics other than chemical pesticides. Table 24 gives the projects of Ing. Feliciano Avalos, project director and Dr. Irwin's counterpart in Peru.

Table 24. Phase IV. Location and Numbers of Experiments for Lowering Population Levels of Key Pests by Methods Other Than Chemical Pesticides

Studies & experiments	Bagua Huarangopampa[a] 1982	1983	1984	Tarapota "El Porvenir[a]" 1982	1983	1984	Tumbes "Los Cedros[a]" 1982	1983	1984
Resistance to insect pests in soybean	1	1	1	1	1	1			1
Population dynamics of arthropods				1			2	2	2
The effect of date of planting on the population level of pests				2	2	2			1
Effect of population levels of *Ceretoma arcuata* on the incidence of nodulation and defoliation of soybean	1	1							
Parasites and predators of eggs of *Pseudoplusia includens* and *Piezodorus guildinii*	1	1							
Soybean varietal tolerance to the damage caused by *Grammopsoides rufipes*				Estacion Experimental Agricola "Vista Florida" - Chiclayo					

[a]Name of agricultural experiment station.

Results and Information About the 1981-82 Research Activities: Results of experiments completed in El Porvenir are published in the following: "INIPA, Centro Investagacion Agropecuaria del Oriente. Soya: Resultados de Investgacion. Informe Especial 05, June 1981. Estacion Experimental "El Porvenir," Tarapata, Peru. 29 pp." This report covers the following four topics: effect of harvest date on the quality of soybean seed; resistant traits in varieties of soybean to Chrysomelidae leaf beetles in the Province of San Martin; how soybean in San Martin can escape the attack of *Anticarsia gemmatalis*; phytophagous insects in soybean in the Province of San Martin.

Ing. Erick Yabar of the Peru soybean entomology team recently published: "Yabar, E. 1980. Insecticidas contra el "Medidor del frijol" *(Pseuoplusia includens)* y su efecto sobre la poblacion dearranas. Revista Peruana de Entomologia 23 (1); 149-150."

Summary of Entomology Accomplishments. During the past year there have been several accomplishments in the areas of INTSOY entomology and pest

management. These include advancements in research and technology transfer for (a) sampling methodologies for aphids as vectors of plant viruses and for important pest predators in the soybean ecosystem, (b) soybean mosaic virus epidemiology and associated virus-vector soybean relationships, and (c) the development and implementation of an insect pest management program for soybean in the high jungle zones of Peru.

Futhermore, substantial progress has been made towards determining the effects of major cultural practices on the behavior and abundance of aphid vectors of soybean mosaic virus and or predator and parasitoid orientation and abundance in soybean and associated crop ecosystems. The impact of aphid behavior has been soundly linked with virus incidence and spread and this, in turn, to soybean yield and seed parameters. Details of these studies are found in IPR-81-1.

Sampling methodology developed by us is used widely within the United States and in several countries in the developing world to monitor aphid vector movement in soybean fields and other crops. Internationally, the methodology has been employed in China, England, Peru, and Ecuador.

The soybean insect pest management program in the high jungle zones of Peru has now been expanded to include the northern coastal zones of Peru. Moreover, AID/Peru is interested in expanding the concepts developed for that program into a national program in pest management involving five basic food commodities and all protection disciplines.

INTSOY supported S. E. Halbert as a graduate student while she developed her Ph.D. dissertation on aspects of soybean mosaic virus epidemiology. Subsequent to finishing her Ph.D., Dr. Halbert received funds for an eight-month research project in the People's Republic of China. Sponsored by the United States National Academy of Sciences, she surveyed soybean mosaic virus incidence and determined activity patterns of aphid vectors at the Nanjing Agricultural College. Dr. Halbert concluded that the major vector species of soybean mosaic virus was *Aphis citricola* in the Nanjing area and not *Aphis glycines* as had been presumed by Chinese scientists. Thus, in a short period of time, she changed the premises of control of soybean mosaic virus spread in an area where severe yield reductions are caused by a pathogen of global importance.

SEEDBORNE PATHOGENS AND FACTORS INFLUENCING THEM

Diseased Seeds and Seed Quality. Research in this area concentrated on disease organisms of soybean seeds which are influenced by various methods of production, harvesting, handling, and storage.

The reaction of cultivars to seedborne fungi was studied. Soybean seeds of sixteen cultivars grown at various locations in Illinois from 1978 to 1981 were assayed for fungi. Surface disinfected seed were incubated for 10 days at 24°C on potato-dextrose agar. Incidence of *Phomopsis* spp. was significantly greater ($P = 0.05$) for Wells (av. 22.2%) and less for Elf (av. 3.3%). Incidence of *Cercospora* spp. ranged from 1.0% for Essex and 1.1% for Elf to 8.1% for Amsoy and 8.3% for Amsoy 71. Incidence of *Alternaria* spp. was significantly greater ($P = 0.05$) for Essex (av. 9.8%) and lower for Elf (av. 2.9%). Seed contaminated with *Cladosporium* spp. ranged from 1.6% for Clark 63 to 4.3% for Essex. For any cultivar, the incidence of *Aspergillus*, *Chaetimium*, *Collectotrichum*, *Fusarium*, *Macrophomina*, or *Penicillium* was less than 2.2%.

Cercospora sojina, which causes frogeye leafspot of soybean, was studied to determine if races of the fungus were present in Illinois. The fungus is highly variable in pathogenicity, colony characteristics, conidium size, and number of septa/conidium (3 to 13), and among isolates from different regions and cultivars. Cultivars resistant in the U.S. are susceptible in other countries. Disease scoring methods in greenhouse inoculations are inconsistent with field evaluations, therefore 66 cultivars (00 to IX) were tested in the field with race 2 and with 9 new isolates. Two disease rating scales were used based on: type and number of lesions on a scale of 0 to 5, where 0 to 2 = resistant, 3 = intermediate, and 4 to 5 = susceptible; and defoliation, where 0 to 5 = resistant, 6 to 9 = intermediate, and 10+ = susceptible. The differentials based on lesion type and defoliation are: Bienville, Blackhawk, Bragg, Capital, Comet, Davis, Dorman, Flambeau, Hampton, Hood, Lee, Mandarin (Ottawa), Patoka, Roanoke, Tanner and Wabash. The nine isolates were identified as seven new races, 5 to 11.

The reaction of soybean cultivars of various maturity groups to various isolates of *C. sojina* were recorded. Twenty-nine cultivars (00 to IV) were inoculated with 10 isolates of *C. sojina* and seeds collected either of two ways: (i) from pods removed by hand from each of 16 cultivars or (ii) from threshed seeds of each of 13 cultivars. All seeds were assayed on blotters. Paired comparisons were made among percent defoliation and seed infection by *C. kikuchii*, *C. sojina*, and *Phomopsis* spp., 100-seed wt. (HSW), percent purple-stained seeds, percent soybean mosaic virus-mottled seeds and germination. The recovery of *C. sojina* varied from 0 to 91.6 There were correlations ($P = 0.0001$) between defoliation, % *C. kikuchii*, and a negative correlation for seed infection by *C. sojina* and *kikuchii*, *Phomopsis* and purple-stained seeds for (i) and HSW and soybean mosaic virus symptoms for (i,ii). The greatest reduction of HSW was due to *C. sojina*. No antagonism was noted between *C. sojina* and *C. kikuchii*. The three fungi do not survive well on seed surfaces after threshing.

Three isolates of the fungal pathogen *Colletotrichum truncata* were obtained from soybean during the 1975 growing season in central and southern Illinois and labeled Cd-1, Cd-2, and Cd-3. The three isolates produced curved conidia measuring between 17.8 to 23.3 μ long and 3.2 to 5.1 μ wide. Growth rate and spore production were variable among the three isolates with Cd-3 producing the most spores per cm^2 of colony growth and Cd-2 producing the largest colony growth at 25°C. Isolate Cd-1, tolerant to benomyl in vitro, showed a uniform radial growth pattern on potato-dextrose agar amended with 1 to 350 μg/ml commercial benomyl, while isolates Cd-1 and Cd-3 showed a bimodal-type growth curve. *Colletotrichum glycine* and *Colletotrichum musae* also were sensitive to benomyl.

Web blight caused by *Rhizoctonia solani* is reported for the first time in Puerto Rico. Disease development was followed in two 0.1-ha fields of Davis soybeans, one sprayed weekly with benomyl (0.25 kg/ha) and the other not sprayed. Symptoms appeared before the full-green stage (R5) in the sprayed plot. The number of disease foci and their size increased with increasing soybean maturity, particularly between the yellow-pod (R7) and the mature-pod (R8) stages. In the unsprayed field, *R. solani* was isolated from 5% of the seeds harvested from web-blighted plants but was not recovered from seeds of adjacent plants without web blight.

Colletotrichum gleosporioides was isolated from prickly sida (*Sida spinois*) growing in soybean plots at the Plant Pathology Research Farm, Urbana. Infected prickly sida plants showed severe leaf blighting, defoliation and large dark stem cankers with the characteristic orange acervuli of *C. gleosporioides*. Heavily infected plants wilted and died. In greenhouse and growth chamber studies, soybean and prickly sida plants were spray inoculated with a conidial suspension of the fungus (1×10^6 spores/ml). All inoculated prickly sida plants developed leaf lesions within 5 days, followed by wilting and death of plants within 14 days. No symptoms developed on either of two soybean cultivars. These results show that *C. gleosporioides* can be used for biological control of prickly sida in soybean fields.

The interaction between several soybean pathogens was studied in the field and laboratory. Soybean cultivars Corsoy 79 and Wells were not inoculated or inoculated with race 10 A of *C. sojina* (or *Phomopsis* sp. alone or in combination). Leaf area at growth stage R6 was significantly ($\underline{P}$. = 0.05) reduced by *C. sojina* and below the fungal combination below the noninoculated control and correlated with 1000 seed weight (r = 0.60). Yield was higher, but not significantly, with the fungal combination compared to *C. sojina*. Both *C. sojina* and *Phomopsis* sp. reduced seed germination, but only *C. sojina* reduced seedling vigor. Both *C. sojina* and *Phomopsis* sp. reduced % clean seeds below either alone. Total number of fungi recovered from seeds was correlated to *C. sojina* (r = 0.77). and to *Phomopsis* sp. (r = 0.51). Fungi significantly reduced seed germination (r = -0.77). *C. sojina* and *Phomopsis* sp. act independently and have an additive effect on deterioration of seed quality.

In another study on interactions between soybean pathogens, culture filtrates from a 24-hr culture of *Pseudomonas syringae* pv. *glycinea* or a 14-day-old culture of *Septoria glycines* was added to flasks containing

soybean broth inoculated with either a 1 x 10^5 conidal suspension of *S. glycines* or a 2 x 10^7 CFU/ml suspension of *P. syringae* pv. *glycinea* Bacterial population counts were recorded after 48 hours at 25°C and mycelial dry weight after 2 weeks at 25°C. Potential antagonism also was studied on Van Teigham cells inoculating one side of the agar disc with the bacterium and the opposite side with the test fungus. Soybean plants were inoculated separately but at the same time with one or both of the pathogens and placed in a growth chamber. No antagonistic or synergistic reaction was noted.

Assessment of Factors that Influence Seedborne Pathogens. Three dessicant herbicides, paraquat, glyphosate and sodium chlorate: sodium borate, and their effect on seedborne pathogens of soybeans was studied.

Alternaria sp., Colletotrichum truncatum, Macrophomina phaseolina, and *Phomopsis* sp., isolated from soybean seeds, differed in tolerance to paraquat as measured by mycelial production, linear mycelial growth, spore germination, and glucose consumption. *Alternaria* sp. was most sensitive to paraquat and *Phomopsis* sp. least sensitive. Paraquat-treated soybean pods released electrolytes and amino acids. The effect of paraquat, glyphosate, and sodium chlorate:sodium borate (50:50) applied at commercial rates was tested on the competitive saprophytic colonization by *M. phaseolina* of greenhouse and field grown soybean stems at three different growth stages in two soils. A significant difference in colonization was recorded between herbicide treatments and controls in soil with a high organic content but no significant difference in colonization was found between herbicides. The highest levels of stem colonization occurred 10 days after incubation in soil. Colonization in treated and untreated stems progressively declined at similar rates for all growth stages and in both soil types. In both soils, field stems had greater levels of colonization when sampling time and herbicide factors were excluded. The nonpersistence of *M. phaseolina* in stems in soil suggest that the saprophytic activity of the fungus does not effectively increase its inoculum density in soil.

Soybean cultivars UFV-1 and UFV-2 grown at Vicosa and Florestal, Brazil, and Bonus and Wells at Urbana, Illinois, were sprayed at growth stages R5.5 to R6 (full-pod) or R7 (50% defoliation) with the desiccant/herbicides glyphosate, paraquat, or sodium chlorate:sodium borate (50:50, w/v). Desiccation of plants by paraquat significantly reduced seed weight and germination at all locations and increased the incidence of *Alternaria* and *Phomopsis* spp. at Urbana. Analysis of the combined data from the Brazilian locations showed a significant decrease in seed germination for all treatments except paraquat sprayed on the UFV-2 at R7 and sodium chlorate:sodium borate sprayed on UFV-1 at R1. Herbicide application at R7 did not result in consistent increases in seedborne *Fusarium* or *Phomopsis* spp. at any Brazilian location. Rainfall and temperature at seed maturation were more important variables in pod-to-seed infection by these fungi than increased rates of tissue senescence caused by the desiccants.

In two separate studies, it was found that beetle populations and various tillage practices can influence the occurrence of seedborne fungi in soybeans. Abnormally high populations of the bean leaf beetle (*Cerotoma*

trifurcata) in 1980 caused extensive injury to soybean pods in some areas of Illinois. Pods and seeds of six soybean cultivars grown near Urbana were examined for injury and assayed for fungal infection and loss of seed germinability. Pod injury was most severe on late-maturing cultivars and least on Elf, the most pubescent cultivar tested. The incidence of seedborne *A. tenuissima* was correlated with pod injury (r = 0.53) and loss of seed germinability (r = 0.63). However, the correlations between pod injury and seed germinability losses varied among cultivars. *Alternaria alternata* was inconsistently observed on seeds infected with *A. tenuissima*, and was less pathogenic. Seed treatment with a mixture of captan plus benomyl increased the germination of seeds from injured pods. In a greenhouse study *A. tenuissima* consistently decayed seeds within artificially injured pods, but did not infect seeds within uninjured pods. *A. alternata*, *A. tenuissima*, and eight other species of fungi known to infect soybeans were isolated from adult bean leaf beetles.

The effect of five tillage systems (conventional, ridge-subsoil, sweep-plot, disk, and no-tillage), and two row spacings (25 cm and 76 cm) on the soybean cultivars Corsoy 79 and Cumberland was studied in 1981. Corsoy 79 matured a week earlier than Cumberland; 25 cm spaced plants were slow initially but finally plants in both spacings matured together. Corsoy 79 at 76 cm matured faster than 25 cm but spacing did not affect maturity in Cumberland. Yield was higher at 76 cm (42.2 q/ha) than 25 cm (38.0 q/ha). Ridge subsoil had significantly ($\underline{P}$. = 0.05) lower yields than other tillages, which did not differ from one another. Narrow-spaced plants were taller, lodged more and thus reduced yields. Taller plants, in general, had more disease and lower seed weight. Ridge-subsoil gave significantly lower seed weight while no-tillage had the highest. Seeds from narrow-spaced plants and from Cumberland have higher recovery of total fungi and bacteria, which affected the percentage clean seeds (r = -0.81 and -0.68, respectively).

Two new techniques were developed for controlling the amount of seedborne fungi in soybean seeds. In the first, refined soybean oil was evaluated as a medium for heating soybean seeds to control seedborne fungi, particularly *Phomopsis* spp. Seeds of various cultivars were heated in hot oil for periods and temperatures ranging from 5 min at 70°C to 20 sec at 160°C. Treatments that decreased the recovery of *Phomopsis* spp., with a concomitant increase in the number of germinable, pathogen-free seeds, ranged from 5 min at 70°C to 10 sec at 140°C. Seeds placed in soybean oil at 27°C did not imbibe oil, swell, or slough their seed coats. In the second, a mixture of 50/50 (v/v) or 60/40 (v/v) glycerin and polyethyleneglycol 400 (PEG) was used to separate *Phomopsis* sp.-infected soybean seeds from noninfected seeds based on density. Water solution approaching saturation using sodium chloride, sucrose, and polyethyleneglycol 6000 were not viscous enough to make the separation. Soybean seeds that did not float on the glycerin-PEG solutions had higher germination and a lower occurrence of *Phomopsis* sp. than seeds that floated. Separation of infected from noninfected seeds was more successful using seeds of Chippewa 64 and Wells than Hark.

The influence of various environmental conditions on the development of soybean rust was studied. PI 230971 and TK 5 soybean plants were inoculated with urediospores of *Phakopsora pachyrhizi* in a growth room programmed

for 12-hr photoperiods (2060 lux), 60-100% relative humidity and diurnal temperatures of 24 ± 1°C (day) and 15 ± 1°C (night). Mature uredia were observed 8 days after inoculation and new uredia continued to form for 30 days, reaching 6.2-6.3 uredia/lesion. TK 5 had maximum urediospore production at day 15, and PI 230971 at day 25 after inoculation. Between 9 and 45 days after inoculation, TK 5 produced 2386 and 12646 and PI 230971 produced 1823 and 9396 urediospores per uredium and per lesion, respectively. More telia were recorded on TK 5 than on PI 230971. The number of telia/cm^2 decreased from the lower to upper leaves on the plant. Source of inoculum from either PI 230971 or TK 5 did not influence telia production. With each increase in inoculum concentration, there was a concomitant increase in telia production. Two-week old soybean plants could be used for telia induction. Telia were produced in soybean leaves after 2 weeks at 10 and 15°C and 3 weeks at 20°C, but not at 25°C. Telia production on soybean leaves in the fields was common when the daily temperature remained below 20°C for more than 15 hr and the average temperature did not exceed 25°C for at least 15 days.

In addition, no rust symptoms were observed on plants from soybean seeds contaminated with fresh urediospores of *P. pachyrhizi* and grown in conditions favorable for rust development or on plants grown in soil infested with soybean leaves with *P. pachyrhizi* uredia. This indicates seed transmission is unlikely.

AUXILIARY ACTIVITIES

The information and training activities support the total INTSOY effort. They serve as a means to disseminate information about INTSOY activities as well as serve as a clearing house for information and activities from soybean scientists around the world.

SOYBEAN INSECT RESEARCH INFORMATION CENTER (SIRIC). The Soybean Insect Research Information Center (SIRIC) is a computerized information storage and retrieval system for the world literature of arthropods associated with soybeans. This commodity-oriented information system provides literature searches, copies of documents, and referral services. Due to the broad scope of its data base SIRIC has been able to attend requests from persons interested in corn, alfalfa, vegetable, and other crops, as well as on nearly 5,000 specific insects. SIRIC's holdings currently include close to 20,000 documents.

Currency of information is an important feature of bibliographic data bases. Similar to the long established commercial data bases SIRIC is as current as possible, but unlike them it also includes the older literature, making it a comprehensive source of bibliographic information on selected subjects.

Services provided by the Center also include verification of bibliographic references for researchers publishing scientific papers or books, answering reference questions, distributing bibliographies of soybean associated arthropods compiled and published by the Center, identifying sources of special unpublished information through direct contact with sources, and doing special searches on subjects not covered by SIRIC's data base.

In 1982 we provided services to individuals in 28 countries answering different kinds of requests (see Table 25). The number and nature of requests fluctuated over the months. A total of 660 requests were processed, 75.6% of them generated outside the U.S. (see Table 26). These requests came from individuals and institutions in the following countries: Argentina, Australia, Bolivia, Brazil, Chile, Colombia, Cuba, Egypt, Ethiopia, Honduras, India, Indonesia, Japan, Kenya, Malaysia, Mexico, Nigeria, Pakistan, Peru, People's Republic of China, Syria, Tanzania, Turkey, Uruguay, U.S., Venezuela, Vietnam, Zaire (see Appendix 2). We established exchanges of scientific literature with some of the 27 foreign countries listed.

SIRIC was visited in 1982 by researchers from the following countries: Argentina, Brazil, Chile, India, Japan, Nigeria, People's Republic of China, Thailand, Uruguay and all the participants in the 1982 INTSOY course "Technical and Economic Aspects of Soybean Production."

To reach a wider community of potential users we have implemented a policy of disseminating information on SIRIC. A leaflet describing the two soybean entomology information systems (SIRIC and IRCSA) has been distributed in international meetings and sent with other SIRIC publications to users abroad. We have a portable display on SIRIC and show it in national and international conferences gaining additional visibility. A

questionnaire was distributed among soybean entomologists for compilation and publication of an International Directory of Soybean Entomologists (see Appendix 3).

Table 25. Summary of Country of Services Rendered by SIRIC During 1982

Country	Number of Requests	Type of Requests[a]
Argentina	13	CB,CD
Australia	7	CB,CD,CS
Bolivia	5	CB
Brazil	51	CB,CD,CS
Chile	12	CB,CD
Colombia	3	CB
Cuba	21	CB,CD,CS
Egypt	21	CB,DC,CS
Ethiopia	10	CB,CD
Honduras	77	CB,CD,CS
India	43	CB,CD,CS
Indonesia	14	CB,CD
Japan	5	CB
Kenya	30	CB,CD,CS
Malaysia	10	CB,CD,CS
Mexico	33	CB,CD,CS
Nigeria	14	CB,CD,CS
Pakistan	12	CB,CD
People's Republic of China	53	CB,CD,CS
Peru	4	CD
Syria	5	CB
Tanzania	5	CB
Turkey	1	CD
Uruguay	21	CB,CD
U.S.	161	CB,CD,CS
Venezuela	14	CB,CD,CS
Vietnam	5	CB
Zaire	10	CB
TOTAL	660	

[a]CB = copies of bibliographies, CD = copies of documents, CS = computer searches.

The *Heliothis* bibliography (INTSOY Series No. 17) was ready for distribution April of 1979. This bibliography was received with great interest by agricultural scientists in the U.S. and abroad. Copies were sent to all participants in the USDA regional projects S-59 and S-74, and to libraries of

most Land Grant Universities and other Universities with strong entomologica programs. It seems, also, that this bibliography has rekindled interest in other four previously published bibliographies on soybean arthrapods. A total of 338 copies of the five bibliographies were distributed in 1982.

Table 26: Monthly Services Provided to Individuals and Institutions in 1982

	Bibliographies	Copies of Documents	Computer Searches	Total Services
January	34(17)[a]	38(18)	13(3)	85(38)
February	15(7)	5(5)	0	20(12)
March	8(1)	6(4)	5(5)	19(10)
April	80(76)	3(3)	3(2)	86(81)
May	18(17)	8(7)	6(3)	32(27)
June	76(72)	3(3)	6(2)	85(77)
July	25(25)	5(5)	17(5)	47(35)
August	2(0)	19(19)	7(4)	28(23)
September	7(7)	11(10)	4(2)	22(19)
October	36(30)	30(24)	9(1)	75(55)
November	30(25)	53(32)	15(3)	98(60)
December	7(6)	55(55)	1(1)	63(62)
Total	338(283)	236(185)	86(31)	660(499)

[a]Numbers in parethehesis refer to requests originating outside the continental USA.

Future Plans

1. Improvement of computerized operations.
2. Completion of coding and processing of soybean entomology (SoyEnt) literature.
3. Editing of SoyEnt literature for publication.
4. Completion and publication of an International Directory of Soybean Entomologists.
5. Development of a network for the exchange of information on soybeans and other grain legumes interfacing SIRIC's capabilities with those of institutions in Brazil (EMBRAPA) and Colombia (CIAT).
6. Develop SIRIC as a prototype for expanded use in other crop protection disciplines to serve the needs of a future International Soybean Center.

Professional Meetings Attended. China/USA Soybean Symposium. July 26-30, 1982, University of Illinois. Joint Meeting of the Entomological Societies of America, Canada, and Ontario, November 29-December 3, 1982, Toronto, Canada.

INTSOY NEWSLETTER AND MAILING LIST

The INTSOY Newsletter was issued quarterly in English, French, and Spanish. The February issue (no. 28) was entitled "Economics of Soybean Production in Peru" and was the last in a series of articles called INTSOY Research Highlights. The May issue (no. 29) examined future needs of soybean research and discussed the possibilities of an International Soybean Center. The August issue (no. 30) discussed improved germplasm for soybean production in the tropics and subtropics. In November (no. 31), we reported on the USAID review of the INTSOY contract, several meetings and symposia, and progress in five countries in soybean production, processing, and use.

We completed the updating of the mailing list for the INTSOY Newsletter and currently have some 2,000 entries. Approximately two-thirds are mailed overseas. All mailings are by bulk rate or surface mail.

A brochure announcing the World Soybean Research Conference III, which will be held at Iowa State University in August, 1984, was mailed out with the November INTSOY Newsletter.

INTSOY PUBLICATION SERIES. Number 22 in the INTSOY Publication series was issued in 1982: "Soybean Seed Quality and Stand Establishment: Proceedings of a Conference of Scientists for Asia," J. B. Sinclair and J. A. Jackobs, editors.

Items in progress include a report on the *Rhizobium* experiments (no. 23); the seventh report of the ISVEX trials (no. 24), and the Proceedings of the First China/USA Soybean Symposium (no. 25).

Demand for INTSOY publications continues. The first printing of numbers 1, 2, 5, and 6 have been been exhausted. Number 6 is being reprinted. There are less than 100 (each) of numbers 3 and 4.

In 1982, INTSOY received 500 requests from 74 countries for 2,030 items. (Unfilled requests for numbers 1, 2, 5, and 6 were not counted.) The distribution by region and publication number are shown in Tables 27 and 28. Table 29 shows the distribution for third world countries. Forty-one percent of the requests (for 47 percent of the items) were sent to third world countries in 1982.

INTSOY publications were displayed in Beijing, People's Republic of China, May, 1982, as part of a book exhibition arranged by CGIAR-sponsored centers.

INTSOY staff reports are listed in Table 30.

Table 27. Distribution of Requests for INTSOY Publications Received at INTSOY Main Office in 1982

Subject areas & publication #	all locations		third world	
conferences (#2,6,10,20,22)	894	(44%)	411	(43%)
ISVEX (#8,11,15,16,19,21)	377	(19%)	198	(21%)
germplasm (#9,13)	123	(6%)	62	(7%)
crop protection (#1,7,17,18)	310	(15%)	145	(15%)
Utilization (#3,4,5,14)	326	(16%)	132	(14%)
TOTAL	2,030		948	

*Table 28. Geographical Distribution of Requests for INTSOY Publications Received at INTSOY Main Office in 1982***

Publication Number	Number of copies by geographical regions: United States and Canada	Latin America	Asia, Middle East, and Australaia	Europe	Africa	Total per Item
1*	4	4	4	1	2	15
2*	17	12	36	1	12	78
3	17	6	16	0	5	44
4	12	8	17	0	7	44
5*	9	4	16	0	3	32
6*	19	10	43	2	14	88
7	17	15	39	8	8	87
8	9	8	25	2	4	48
9	22	14	21	1	6	64
10	12	7	34	1	8	62
11	7	6	24	2	4	43
12	12	12	31	3	5	63
13	22	14	22	0	1	59
14	24	16	142	4	20	206
15	6	9	18	3	5	41
16	6	12	19	3	5	45
17	65	13	22	3	5	108
18	23	17	49	5	6	100
19	17	13	23	5	6	64
20	83	51	40	36	14	224
21	54	22	42	8	10	136
22	199	54	74	39	13	379
	656	327	757	127	163	2,030
Requests per region	215	66	145	32	42	500

*Unfilled requests for these out-of-print items were not counted.
**Does not include requests sent to individual INTSOY staff members or general mailings when an item is issued.

*Table 29. Distribution of Requests for INTSOY Publications Received at INTSOY Main Office to Third World Countries in 1982***

Publication Number	Geographical Regions			Total per Item
	Latin America	Asia	Africa	
1*	2	5	2	9
2*	4	34	12	50
3	1	15	5	21
4	3	15	7	25
5*	1	15	3	19
6*	5	41	14	60
7	7	35	7	49
8	3	22	4	29
9	9	18	6	33
10	1	31	8	39
11	1	22	4	27
12	1	28	5	34
13	9	19	1	29
14	9	39	19	67
15	4	16	5	25
16	7	17	5	29
17	8	21	5	34
18	13	43	6	62
19	7	20	6	33
20	40	37	14	91
21	10	35	10	55
22	46	69	13	128
	191	596	161	948
Requests Per Region	43	124	40	207

*Unfilled requests for these out-of-print items were not counted.
**Does not include reqeusts sent to individual INTSOY staff members or general mailings when an item is issued.

Table 30. INTSOY Staff Reports, 1982

Publication number and title	Date	Author
ISR-82-1- Planning Regional ICA/INTSOY Soybean Production Training	Feb. 1982	J. W. Santas
ISR-82-2- Australia	April 1982	J. B. Sinclair
ISR-82-3- Indonesia	April 1982	J. B. Sinclair
ISR-82-4- Thailand	April 1982	J. B. Sinclair
ISR-82-5- Taiwan	May 1982	J. B. Sinclair
ISR-82-6- Soybean Research and Production in Egypt	April 1982	J. A. Jackobs
ISR-82-7- Soybean Research and Production in Turkey	April 1982	J. A. Jackobs
ISR-82-8- Visit to CIAT in Connection with Establishing of INTSOY Regional Site	Oct. 1982	T. A. McCowen
ISR-82-9- Visit to Denmark to Participate in International Symposium on Seed Pathology, Hellerup, Denmark	Oct. 1982	J. B. Sinclair
ISR-82-10-Determine Disease Problem of Soybeans in Adana Region of Turkey	Oct. 1982	J. B. Sinclair
ISR-82-11-Participation in EEC/IITA High-Yielding Varieties Technology Project in Nigeria	Oct. 1982	J. B. Sinclair
ISR-82-12-Visit to NifTAL, Philippines, Thailand India, FAO/Rome, and Spain	Sept./Oct. 1982	H. E. Kauffman
ISR-82-13-Visit to India	Sept./Oct. 1982	H. E. Kauffman J. A. Jackobs
ISR-82-14-Visit to ASA Headquarters in St. Louis, Missouri, for Possible Collaboration Between INTSOY and ASA	Oct. 1982	H. E. Kauffman
ISR-82-15-Visit to AID/Washington, D.C., to Discuss Future Funding of INTSOY Projects	Nov. 1982	H. E. Kauffman
ISR-82-16-Trip to Washington, D.C. to Meet with Directors of International Research Centers and Visit the National Soybean Processors Association and National Soy Protein Council	Nov. 1982	H. E. Kauffman
ISR-82-17-ICA/INTSOY Soybean Production Course For Latin America and the Caribbean, Palmira, Colombia	Dec. 1982	J. W. Santas
ISR-82-18-Mycoplasm-like Disease of Soybean in Southern Mexico	Nov. 1982	J. Fletcher M. E. Irwin

TRAINING ACTIVITIES

Training, while not a specific objective of the research contract, involves the INTSOY staff and contributes to the overall goal of the project by imparting knowledge to soybean workers who translate the knowledge into action programs in LDCs. INTSOY training has concentrated on short courses offered on the UIUC campus and abroad, with a substantial amount of knowledge sharing with visitors.

Two short courses have been conducted on the UIUC campus since 1975. The twelve-week course, "Technical and Economic Aspects of Soybean Production," has been offered each of the past eight years and has been attended by 101 persons from 42 countries. The companion seven-week course, "Soybean Processing for Food Uses," has been offered seven times to a total of 79 persons from 36 countries.

In 1979 a three-week soybean production course was held in Palmira, Colombia, in cooperation with ICA for 17 extension agents who were involved in the AID/INTSOY soybean development project in Peru. The course was offered again in 1980 and 1982 with enrollment opened to all Latin American and Caribbean scientists able to arrange financial support. To date, 69 persons from 14 countries have participated in this Colombia-based course which is conducted entirely in Spanish.

The Colombian course has demonstrated that INTSOY can combine resources with other organizations to present effective training overseas. Dialogue is now going on between IITA and INTSOY, and between the Sri Lanka Soybean Project and INTSOY, which should lead to future regional courses to serve West African and Asian soybean production and processing scientists.

A large percentage of the total number of international visitors who come to the University of Illinois appear on campus specifically because of INTSOY. In 1982 the training officer worked with a total of 53 visitors from 12 different countries who wanted to learn about INTSOY or confer with INTSOY staff. Records verify that over the past three years a total of 374 persons from all regions of the world have come to UIUC as INTSOY visitors.

CONFERENCE AND TRAVEL ACTIVITIES

Conferences. INTSOY jointly organized the following conferences during 1982:

a) China/USA Soybean Symposium and Working Group Meeting, July 26-30 at the University, Urbana, Champaign, funded by the OICD of the United States Department of Agriculture. Seven Chinese soybean scientists and approximately 30 from the U.S.A. presented papers or lead discussion groups on subjects of mutual interest. Approximately 200 people from various research organizations from government and private industry attended the Symposium. Priority areas were identified for future collaborative activities and plans were developed for the Chinese to host a follow-up conference in 1983. Proceedings of the Symposium are in press as INTSOY Series Number 25.

b) IBPGR Working Group on the Genetic Resources of *Glycine* Species, August 9-11 at the University of Illinois, Urbana, Champaign, funded by the IBPGR. Soybean scientists from 8 countries participated in the discussions. Descriptors for *Glycine max* were drafted and a global strategy for the inventory, collection, and acquisition of soybean germplasm was developed.

INTSOY scientists also participated in several conferences in other countries. Among those attended were the International Symposium on Seed Pathology, Copenhagen, Denmark; EEC/IITA High-Yielding Varieties Technology Project, IITA, Ibadan, Nigeria; and European Soybean Network Conference, Seville, Spain.

Travel. INTSOY scientists visited the following countries during 1982 to discuss collaborative activities with soybean scientists or as consultants to assist in the strengthening of national soybean programs.

Africa: Nigeria

Asia: China (Taiwan)
India
Indonesia
Philippines
Sri Lanka
Thailand
Turkey
Vietnam

South and Central America: Colombia
Costa Rica
Guatemala
Mexico
Panama
Peru
Venezuela

ADMINISTRATION AND BUDGET

EXPENDITURES AND PROJECT STAFF

PROGRAM OF EXPENDITURES

		Contract Period 4/1/76-12/31/81	Report Period 1/1/82-12/31/82	Total Expenditures 4/1/76-12/31/82
1.	Salary & Wages	$1,928,140.00	$463,190.00	$2,391,330.00
	A. Professional	(1,263,025.00)	(383,285.00)	(1,646,310.00)
	B. Support	(665,115.00)	(79,905.00)	(745,020.00)
2.	Fringe Benefits	216,375.00	44,837.00	261.212.00
3.	Indirect Costs	1,188,709.00	310,446.00	1,499,155.00
4.	Travel and Transportation	256,599.00	42,290.00	298,889.00
5.	Other Direct Costs	288,537.00	82,002.00	370,539.00
6.	Equipment and Supplies	315,112.00	27,110.00	342,222.00
	TOTAL	$4,193,472.00	$969,875.00	$5,163,347.00

APPENDIX 1: ISVEX 1982 COOPERATORS/ORGANIZATIONS

No.	Country	Cooperator	Organization	Trials(s)#	A	B	C
1.	Algeria	I.D.C.I.		703		1	
2.	Argentina	Suarez	INTA-EERA	733		2	
	Argentina	Siciliana	Compania Continetnal S.A.	Exclusive			
	Argentina	Mancuso	INTA	731		3	
	Argentina	Remussi	Facultad de Agronomia	732		4	
	Argentina	Feldman	Catedra de Fisiologia Vegetal	Exclusive			
3.	Australia	Roe	Department of Ag.	590, 737	1	5	
4.	Bahamas	Smith	Min. of Ag. Central Ag'l Station	518, 519	2, 3		
5.	Bangladesh	Ag. Administrator	Mennonite Central Committee	583, 584	4, 5		
6.	Bolivia	Saravia	CORGEPAI	580, 581	6, 7		
	Bolivia	Valle	Fundacion Centra El Hambre	721		6	
	Bolivia	Natav	Eisenberg Company	571	8		
7.	Brazil	Carraro, Fonseca	OCEPAR	592, 734	9		7
8.	Burma	Ko		560	10		
9.	Cameroon	Salez	Institute of Ag. Research	559, 502	11, 12		
10.	Central African Republic	Linquist	Africa Inland Research	528	13		
11.	Chile	Parodi	Catholic U. of Chile	841			1
12.	People's Rep. China	Weng	Academy of Heilongjiang	830			2

APPENDIX 1: ISVEX 1982 COOPERATORS/ORGANIZATIONS

No.	Country	Cooperator	Organization	Trials(s)#	A	B	C
13.	Colombia	Ramos	ICA	501, 502	14, 15		
14.	Costa Rica	Monge, Gomez	AID-MAG	555	16		
	Costa Rica	Mata	CARE	573	17		
15.	Cyprus	Hadjichristodoylou	Agriculture Research Institute	708		8	
16.	Czechoslovakia	Sinsky, Pastucha	Genetic Institute	813			3
17.	Dominican Rep.	Rodriguez	CESDA	543	18		
18.	Ecuador	Maldonado	INIAP	511,512	19, 20		
19.	Equatorial Guinea	Reupke	African Asian Bureau	534,582	21, 22		
20.	Egypt-MNSU	Baca	International Program	Exclusive			
	Egypt-MNSU	Baca	International Program	824-827			4-7
	Egypt	Faculty of Ag.	Suez Canal U.	704,804		9	8
	Egypt	Ashour	National Research Center	707		10	
	Egypt	Hassan	Field Crops Res. Institute	Exclusive			
	Egypt	Allam	U. of Ain Shams	801		9	
21.	England	Bowles	U. of Leeds	Exclusive			
22.	Ethiopia	Ali	Institute of Ag'l Research	535	23		
23.	Fiji	Fernando	U. of S. Pacific, Alafua Campus	542	24		
	Fiji	Singh	Ministry of Ag. & Fisheries	505	25		
24.	French Guiana	Godon	IRAT	504	26		
25.	Gabon	Dupont	UNDP	574	27		
	Gabon	Plas	UNDP	503, 507, Exclusive	28		

APPENDIX 1: ISVEX 1982 COOPERATORS/ORGANIZATIONS

No.	Country	Cooperator	Organization	Trials(s)#	A	B	C
26.	Ghana	Acquaah	U. of Cape Coast	510	30		
	Ghana	Schmidt	Agro Industries	514	31		
27.	Greece	Skaracis	University	805		10	
28.	Guatemala	Gomez-Arauz	ICTA	579,557, 558	32, 33 34		
29.	Rep. of Guinea	Camara	INRAF	575, 576	35, 36		
30.	Haiti	Galluccio	Eisenberg and Co.	566	37		
	Haiti	Natav	Eisenberg and Co.	577	38		
	Haiti	Hutchinson	U. of Maine	Exclusive			
31.	Honduras	Paz	Escuela Agricola Panamericano	548	39		
32.	India	Bhatnagar	NBPGR	Exclusive			
33.	Indonesia	Baru	Gatot Subroto	521	40		
	Indonesia	Tampubolon	Departmen Agronomi	525	41		
	Indonesia	Djojodirdjo	Gadjah Madu U.	515, 516	42, 43,		
	Indonesia	Hidayat, Siwi	Sukamandi Research Inst. for Food Crops	517	44		
34.	Iran	Sarafi	College of Agriculture	829, 702 800, 802	12	11, 13, 14	
35.	Iraq	Rajan	UNDP	700, 701	11	12	
36.	Israel	Zur	Ag'l Res. Org.	Exclusive			

APPENDIX 1: ISVEX 1982 COOPERATORS/ORGANIZATIONS

No.	Country	Cooperator	Organization	Trials(s)#	A	B	C
37.	Italy	Cavicchioli	Instituto Agricoltura Montana	844			15
	Italy	Sgaravatti	FAO	Exclusive			
	Italy	White	FAO	Exclusive			
	Italy	Porreca	BIOAG	817			16
38.	Ivory Coast	Roger	Min. of Agriculture	561, 562	45, 46		
39.	Jamaica	Ramsay	Min. of Agriculture	513, 568, 569	47, 48, 49		
40.	Jordan	Haddad	U. of Ag.	706		13	
41.	Kenya	Nzabi	Nyanza Ag'l Research Station	Exclusive			
42.	South Korea	Eun-Hi	Crop Exp. Station	831			17
43.	Lesotho	Tewari	Min. of Ag. and Marketing	839, 810			18, 19
44.	Malagasy Rep.	Richard	MAMISOA	578, 727	50	14	
45.	Malaysia	Chia	Ag'l Research Centre, Semongok	524	51		
46.	Mauritius	Owadally	Min. of Ag., Nat. Resource & the Environment	565	52		
47.	Mexico	Tanaka		508	53		
	Mexico	Rivera de L.	CIAPY	563	53		
	Mexico	Hatem	INIA-CIAGON	537, 538, 539, 715	55, 56, 57	15	

APPENDIX 1: ISVEX 1982 COOPERATORS/ORGANIZATIONS

No.	Country	Cooperator	Organization	Trials(s)#	A	B	C
48.	Morocco	Abdouh	IAVH,II(DSS)	823, 828			20
	Morocco	Driss	Min. of Ag. & Agrarian Reform	713, 815		16	22
49.	Mozambique	Baes	UNDP	531	58		
	Mozambique	Sichmann	FAO/UNDP/Soya Devel.	585, 730	59	17	
50.	Nepal	Sharma	ISAA/MUCIA	822, 838			23 24
51.	New Caledonia	Devinck, Severian	Recherche Agronomique	590	60		
52.	New Hebrides	Calvez	IRHO	523	61		
53.	Nicaragua	Schnepel	EJE ECUMENICO	589	62		
54.	Nigeria	Kueneman	IITA	Exclusive			
55.	Pakistan	Economic Botanist	Ag'l Research Council	840			25
	Pakistan	FAO Rep.	FAO	714, 818, 819, 820 821		18	26 27 28 29
	Pakistan	Lockman	Tech. Services Assoc. Ag'l Project	601, 602 603, 604 605	63 64 65 66 67		
	Pakistan	Beg	Ag'l Research Council	833, 834			30
	Pakistan	Chaudry	Ag'l Research Inst.	717		19	
56.	Paraguay	Casaccia, Lopez Aguilera, Alvarez	Ministerio de Agricultura y Ganaderia	726			20
	Paraguay	Wang	Mission Tecnica Agricola de China	725		21	
57.	Peru	Saco	INIPA	1000	68		

APPENDIX 1: ISVEX 1982 COOPERATORS/ORGANIZATIONS

No.	Country	Cooperator	Organization	Trials(s)#	A	B	C
58.	Philippines	Natav	Eisenberg and Co.	536	69		
	Philippines	Grande	Twin Rivers Research Center	506	70		
	Philippines	Izuno	Pioneer Overseas Corp.	591, 593	71, 72		
	Philippines	Agbisit	Isabela State U.	529	73		
	Philippines	Legaspi	Bureau of Plant Indus.	533	74		
59.	Portugal	Carvao	APO	809			32
	Portugal	Gaspar	INIA	814			33
60.	Puerto Rico	Stearn	INTSOY	Exclusive			
	Puerto Rico	Bravo	INTSOY	Exclusive			
	Puerto Rico	Camacho	INTSOY	Exclusive			
	Puerto Rico	Isabela Ag'l Exp. Station	INTSOY	530	75		
61.	Reunion	Marchand	IRAT	594, 738	76	22	
62.	Saudi Arabia	Samarrai	King Abdulaziz U.			23	
	Saudi Arabia	Trabulsi	Riyadh U.	Exclusive			
	Saudi Arabia	Lin		551, 718	77	24	
63.	Senegal	Larcher	ISRA/CNRA	540	78		
64.	Somalia	Mokhtarzadey	UNDP	520 710	79	25	
65.	Spain	Gutierrez-Mas.	Min. de Ag.	Exclusive			
	Spain	Montes	Estacion Exp'l del Zaidin	Exclusive			
	Spain	Leidi	" " " "	Exclusive			
66.	Sri Lanka	Dharmasena	Soybean Project Office	509	80		
67.	Sudan	Kanani	ARC	545	81		
	Sudan	Sarrag	Hudeiba Research Station	532	82		

APPENDIX 1: ISVEX 1982 COOPERATORS/ORGANIZATIONS

No.	Country	Cooperator	Organization	Trials(s)#	A	B	C
	Sudan	Ghobrial	ARC	712		26	
	Sudan	Ageeb	ARC	Exclusive			
	Sudan	El-Sherbeeny	ARC	719			
68.	Swaziland	Jansma	Penn State U.	734, 736 842		28	34
69.	Syria	Masouker, Saleh	Min. of Ag. and Agrarian Reform	705, 803			
70.	Tahiti	Reboul	GERDAT-IRAT	522	83		
71.	Taiwan	Shanmugasundaram	AVRDC	544, 716	84	31	
72.	Tanzania	Carpenter	FAO	549, 595	85 86		
73.	Thailand	Tongdee	Dept. of Agriculture	556	87		
	Thailand	Srinives	Kasetsart University	567	88		
74.	Togo	Chef de la Mission	IRAT/Togo	546	89		
75.	Turkey	Isgin	Min. of Ag. and Forestry	Exclusive 835, 836			
	Turkey	Bilgin	Seker Enstitusu	806, 807			38
	Turkey	Nulci	Seker Enstitusu	709, 808		32	40
	Turkey	Kutlu	Reg'l Ag'l Research Institute	816			41
	Turkey	Atakisi, Arioglu	G. U. Ziraat Fakultesi	837			42
76.	Uganda	USAID Ag'l Rep.	USAID	740	33		
77.	United States	Goodman	Calgene, Inc.	Exclusive			
	United States	Koch	Australian Missionary	Exclusive			
	United States	Creelman	Texas Ag. Exper. Sta.	570	90		

APPENDIX 1: ISVEX 1982 COOPERATORS/ORGANIZATIONS

No.	Country	Cooperator	Organization	Trials(s)#	A	B	C
78.	Upper Volta	Director	IRHO/H.V.	547	91		
79.	Uruguay	Chebataroff Deambrosi	Estacion Exp'l del Este	729			34
	Uruguay	Sgaravatti	FAO	Exclusive			
	Uruguay	Amendola	Est. Exp'l del Norte	728		35	
80.	USSR	Vitkovsky	Inst. of Plant Indus.	Exclusive			
81.	Venezuela	Rodriguez	Fundacion Servico Para El Agricultor	550	92		
82.	Vietnam	Hlava	FAO	724			36
	Vietnam	Thang	National Inst. of Ag'l Science	596	93		
83.	Yugoslavia	Dumanovic	Maize Research Institute	811, 812			43
84.	Zaire	Nguyen Elukesu, Bouwe	MASI/INERA	720		37	
	Zaire	Stuffle	Covenent World Mission	564	94		
85.	Zambia	Javaheri	FAO	586, 587	95		
				588	96		
					97		
86.	Zimbabwe	Tatterfield, Tichagwa	Crop Breeding Institute	723			38

APPENDIX 2: SUMMARY BY MONTH, COUNTRY, AND INSTITUTIONS OF SERVICES RENDERED BY SIRIC DURING 1982

Month	Country	Institute	Name	Number of Biblio-graphies	Number of Documents	Number of Computer Searches
January	Honduras	Panamerican School of Agriculture	F.E. Bencosme	5	2	-
	Nigeria	International Institute of Tropical Agriculture	R. I. Egwatu	1	9	1
	Nigeria	International Institute of Tropical Agriculture	L. Jackai	1	-	2
	Pakistan	Pakistan Agricultural Research Council	A. Beg	5	7	-
	Vietnam	Faculty of Agri. Univ. of Cantho	Vo-Tong Xuan	5	-	-
February	Australia	Divison of Agriculture and Stock	A. Allwood	2	-	-
	Ethiopia	Institute of Agricultural Research	T. Abate	5	5	-
March	Brazil	EMBRAPA	B.P. das Neves	1	-	5
	Peru	--	C.H. Vilcarraomero Detquizan	-	4	-
April	Brazil	CNP Soja/EMBRAPA	D. Gazzoni	-	-	1
	Chile	--	M. A. Habit	5	2	-
	Colombia	--	E. P. Torres	3	-	-
	Honduras	DARCO	L. A. G. Arias	1	-	-
	Honduras	Dept. of Agronomy	A. J. Caballero	1	-	-
	Honduras	--	M. G. Chavez	1	-	-
	Honduras	--	E. Dalyrmple	5	-	-
	Honduras	Dept. of Agriculture	R.E.R. Espinoza	2	-	-
	Honduras	--	G. Evans	5	-	-
	Honduras	--	J. B. G. Funes	5	-	-
	Honduras	Office of Natural Resources	H.B.M. Grita	5	-	-
	Honduras	Peace Corps	R. Lind	5	-	-
	Honduras	Dept. of Natural Resources	B. Mejia Y.M.	5	-	-
	Honduras	Dept. of Agriculture	F. A. Montenegro	3	-	-

APPENDIX 2: SUMMARY BY MONTH, COUNTRY, AND INSTITUTIONS OF SERVICES RENDERED BY SIRIC DURING 1982 (cont'd)

Month	Country	Institute	Name	Number of Bibliographies	Number of Documents	Number of Computer Searches
April	Honduras	Dept. of Agriculture	F. A. Montenegro	3	-	
	Honduras	Dept. of Agriculture	R. Ordonez A.	5	-	-
	Honduras	--	J.T. Pereira A.	2	-	-
	Honduras	Dept. of Agriculture	C.A.N. Piro	5	-	-
	Honduras	National Program of Agricultural Research	H. Rittenhouse	2	-	-
	Honduras	Office of Natural Resources	S.Q. Rivera	2	-	-
	Honduras	National Center of Agriculture	L.A. Sarantez	1	-	-
	Honduras	National Program of Agricultural Research	J.A. Sauter	5	-	-
	Honduras	--	R. Valdez	1	-	-
	Honduras	Office of Natural Resources	G.A.F. Valladares	1	-	-
	Honduras	DARCO	M.M. Valle	3	-	-
	Honduras	Office of Natural Resources	M. de J. Viera	3	-	-
	India	--	R. Singh	-	-	1
	Turkey	Arastirma Enstitusu	K. Turkoglu	-	1	-
May	Australia	Dept. of Agriculture-Western Australia	M. Heap	-	2	2
	Australia	Dept. of Primary Industries	J.J. Titmarsh	1	-	-
	Bolivia	CIAGRO	J.S. Landivar	5	-	1
	India	Division of Entomology-Indian Agriculture Research Institute	H.P. Saxena	-	-	1
	India	--	R. Singh	1	-	-
	Japan	Faculty of Agriculture Kyushu University	Editor of Esakia	5	-	-
	Uruguay	Dept. of Plant Pathology	W. Chiaravalle	5	5	-
June	Brazil	Federal University of Parana	E.R. Silveira	5	-	-

APPENDIX 2: SUMMARY BY MONTH, COUNTRY, AND INSTITUTIONS OF SERVICES RENDERED BY SIRIC DURING 1982 (cont'd)

Month	Country	Institute	Name	Number of Biblio-graphies	Number of Documents	Number of Computer Searches
June	Chile	Experimental Station La Platina	V. Valdira	5	-	-
	Egypt	Plant Protection Research Institute	M. Fahmi A.H.	5	1	1
	Egypt	Food Legume Research Station	M.Z. Hassam	4	-	-
	Egypt	Plant Protection Research Institute	Z. R. Sawries	5	1	1
	India	International Center for Agricultural Research	K. A. Pathak	5	1	-
	India	Oilseeds Growers Assoc.	M.S. Singh Deo	5	-	-
	India	Oilseeds Growers Assoc.	M.D. Tedia	5	-	-
	Indonesia	Bogor Research Institute for Food Crops	A. Dimyati	5	-	-
	Kenya	Nyanza Agricultural Research Station	W.A. Nzabi	5	-	-
	People's Republic of of China	Institute of Plant Protection	Q. Yuan	3	-	-
	Syria	Plant Production Dept. of Damascus Univ.	M. Sabbouh	5	-	-
	Tanzania	--	E.T. Marenge	5	-	-
	Venezuela	Central University of Venezuela	H. Geraldo V.	5	-	-
	Zaire	INERA	P.M. Mulendo	5	-	-
	Zaire	INERA	M.N. Tshidimba	5	-	-
July	Brazil	Institute of Agronomy	--	5	-	-
	Cuba	Institute for Fundamental Investigations in Tropical Agriculture	M. Gonzalez	5	-	-
	Egypt	--	M. Hassan	-	-	3
	Honduras	--	S. Rivera	-	2	-
	India	ICAR Research Complex for N.E.A. Region Shillong	K.A. Pathak	-	-	1

APPENDIX 2: SUMMARY BY MONTH, COUNTRY, AND INSTITUTIONS OF SERVICES RENDERED BY SIRIC DURING 1982 (cont'd)

Month	Country	Institute	Name	Number of Biblio-graphies	Number of Documents	Number of Computer Searches
August	People's Republic of China	Institute of Plant Protection	Q. Yuan	5	-	-
	Uruguay	Dept. of Plant Pathology	W. Chiavaralle	5	-	-
	Venezuela	--	J. Gonzalez	5	3	1
	Cuba	Dept. of Plant Pathology	A. Castineiras	-	6	1
	India	Division of Entomology-Indian Agricultural Research Institute	H.P. Saxena	-	13	-
	People's Republic of China	Institute of Plant Protection	Q. Yuan	-	-	3
September	Brazil	Union Carbide	M. Margulis	2	5	-
	Brazil	Univ. of Piracicaba	J. Parra	-	1	-
	Cuba	Dept. of Plant Pathology	A. Castineiras	5	4	-
	People's Republic of China	Institute of Plant Protection	Q. Yuan	-	-	2
October	Argentina	Dept. of Agricultural Sciences	R. E. Breredon	5	4	-
	Argentina	Faculty of Agronomy and Veterinary Medicine	L. Cholsky	-	3	-
	Brazil	National Institute of Agricultural Technology	H.G. Bimboni	5	4	-
	Brazil	--	U.D. Machado	5	4	-
	India	Dept. of Entomology and Apiculture	N. P. Kashyap	5	4	-
	Malaysia	Agricultural Research Center	E.S. Sim	5	4	1
	Uruguay	Ministry of Agriculture and Fisheries	L.A. Amendola	5	1	-

APPENDIX 2: SUMMARY BY MONTH, COUNTRY, AND INSTITUTIONS OF SERVICES RENDERED BY SIRIC DURING 1982 (cont'd)

Month	Country	Institute	Name	Number of Biblio-graphies	Number of Documents	Number of Computer Searches
November	Argentina	--	O. Giayetto	-	1	-
	Brazil	EMBRAPA	E. Bleicher	-	1	-
	Brazil	EMBRAPA	U. Dantas	-	2	-
	Brazil	EMBRAPA	U. Dantas 5 Machado	-	-	
	Indonesia	Pengamatan Dan Laboratory	Dr. Zulkaranaen	5	4	-
	Kenya	International Center of Insect Physiology and Ecology	R.P. Ortega	5	4	-
	Mexico	UNACH	J. Telford	10	20	3
December	India	IARI	B. Upendranath Singh	1	-	-
	Nigeria	International Institute of Tropical Agriculture	L. Jackai	-	15	-
	Nigeria	International Institute of Tropical Agriculture	S. Singh	-	-	1
	People's Republic of China	Institute of Plant Protection	Q. Yuan	-	40	-
				283	185	31

APPRENDIX 3: SOYBEAN INSECT RESEARCH INFORMATION CENTER (SIRIC)

Jenny Kogan, Coordinator
University of Illinois and Illinois Natural History Survey
172 Natural Resources Building, 607 E. Peabody
Champaign, Illinois 61820 U.S.A.

WORLD DIRECTORY OF SOYBEAN ENTOMOLOGISTS

NAME — Last name | 1st full name | mid. initial

TITLE

INSTITUTION

ADDRESS — Street and Number

Town or City | State of Province | Zip

Country | Phone Number

SPECIALITIES and INTERESTS (rank in order of importance)

Areas of Speciality	Groups of Interest
1. Ecology	A. Predators
2. Behavior	B. Parasites
3. Toxicology	C. Lep. Defoliators
4. Taxonomy	D. Stink Bugs
5. Genetics	E. Pod Borers
6. Modeling	F. Soil Arthropods
7. Ins. Pathology	G. Spider Mites
8. Bio Control	H. Aphids
9. Chemical Control	I. Coleop. Defoliators
10. Plant Resistance	J. Spiders
11. Cultural Control	K. Total Fauna
12. Others (specify):	L. Others (specify):

Others in my Institution Who Should Be Listed:

APPENDIX 4: LIST OF PUBLICATIONS BY INTSOY STAFF APPEARING OR SUBMITTED DURING THE 1981-82 REPORT PERIOD

Agarwal, V. K., and J. B. Sinclair. 1982. Seed dressings and *Rhizobium* inoculum. Pages 121-125 in J. B. Sinclair and J. A. Jackobs, eds., Soybean Seed Quality and Stand Establishment. University of Illinois at Urbana-Champaign, College of Agriculture. INTSOY Publ. no. 22.

Avalos Q., F., and M. E. Irwin. 1981. Plagas de las leguminosas alimenticias. Vol. 3, article 41, 9p. in F. Cisneros, ed., Segundo Curso Intensivo, Control Integrado de Plagas y Enfermedades Agricolas. La Molina, Peru. 3 volumes.

Bisht, V. S., J. B. Sinclair, J. W. Hummel, and R. D. McClary. 1982. Effect of tillage systems on yield components and disease of soybeans. Phytopathology 72:1134.

Bisht, V. S., and J. B. Sinclair. 1982. Interaction of *Cercospora sojina* and *Phomopis sojae* on soybean seed quality and yield components. Phytopathology 72:944.

Bowers, G. R., Jr., and R. M. Goodman. 1982. New sources of resistance to seed transmission of soybean mosaic virus in soybeans. Crop Science 22:155-156.

Bowers, G. R., Jr., and R. M. Goodman. Effect of strains of soybean mosaic virus on soybean seed characters. In preparation for Phytopathology.

Bowers, G. R., Jr., E. H. Paschal II, R. L. Bernard, and R. M. Goodman. Inheritance of resistance to soybean mosaic virus. In preparation for Crop Science.

Cerkaukas, R. F., O. D. Dhingra, and J. B. Sinclair. 1981. Efeito de desiduo de herbicidas deseccantes em ramos de soja na colonizacao saprofitica para *Macrophomina phaseolina* (Effect of desiccating herbidide residues in the soybean stem, on the saprophytic colonization of *Macrophomina phaseolina*). Fitopatologia Brasileria 6:567.

Cerkauskas, R. F., O. D. Dhingra, and J. B. Sinclair. 1982. Effect of competitive saprophytic colonization by *Macrophomina phaseolina* of soybean stems. Transactions of the British Mycological Society 79:201-205.

Cerkauskas, R. F., O. D. Dhingra, J. B. Sinclair, and S. R. Foor. 1982. Effect of three desiccant herbicides on soybean (*Glycine max*) seed quality. Weed Science 30:484-490.

Cerkauskas, R. F., and J. B. Sinclair. 1982. Effect of paraquat on soybean pathogens and tissues. Transactions of the British Mycological Society 78:495-502.

APPENDIX 4: LIST OF PUBLICATIONS BY INTSOY STAFF APPEARING OR SUBMITTED DURING THE 1981-82 REPORT PERIOD (cont'd)

Cho, E. K., and R. M. Goodman. 1982. Evaluation of resistance in soybeans to soybean mosaic virus strains. Crop Science 22:1133-136.

Cho, E. K., and R. M. Goodman. 1982. Field spread of soybean mosaic virus strains. Korean Journal of Plant Protection (In press).

Cubeta, M. A., and J. B. Sinclair. 1982. Interaction between *Septoria glycines*. and *Pseudomonas syringae* pv. *glycines*. Phytopathology 72:1382.

Goodman, R. M. 1982. Ultrasensitive methods for detection of geminiviruses and their genomes. Journal of Agriculture of the University of Puerto Rico.

Goodman, R. M., and M. E. Irwin. 1981. Whitefly-transmitted viruses in tropical agriculture. Pages 3-4 in The Programme and Abstracts of the International Workshop on Pathogens Transmitted by Whiteflies. Oxford, England, July, 1981.

Haber, S., J. E. Polston, and J. Bird. A malvaceous perennial weed is a host of bean golden mosaic virus in Puerto Rico. In preparation for Plant Disease.

Haber, S., R. M. Goodman, and J. Bird. Detection and identification of geminivirus strains from Puerto Rico by Southern analysis. In preparation for Phytopathology.

Hepperly, P. R., J. S. Mignucci, J. B. Sinclair, R. S. Smith, and W. H. Judy. 1982. Rhizoctonia web blight of soybeans in Puerto Rico. Plant Disease 66:256-257.

Hepperly, P. R., J. S. Mignucci, and J. B. Sinclair. 1982. The microorganisms of stored soybean seeds. Pages 67-76 in J. B. Sinclair and J. A. Jackobs, eds., Soybean Seed Quality and Stand Establishment. University of Illinois at Urbana-Champaign, College of Agriculture, INTSOY Publ. no. 22.

Hepperly, P. R., and J. B. Sinclair. 1982. A glycerin and polyethylene-glycol solution for separating healthy and diseased soybean seeds. Seed Science and Technology 10:125-129.

Heydon, S., and M. E. Irwin. 1982. Influence of wind on the flight direction of parasitic Hymenoptera. Abstract of submitted paper. Annual meeting, Entomological Society of America. Toronto, Canada, November 1982.

Irwin, M. E. 1981. Evaluacion de la densidad de poblaciones de insectos y el concepto de niveles de dano economico. Vol. 2, pages 105-116 in F. Cisneros and E. Trujillo, eds., Curso Internacional de Control Integrado de Plagas. Instituto de Ciencia y Tecnologia Agricolas, Guatemala. 3 volumes.

APPENDIX 4: LIST OF PUBLICATIONS BY INTSOY STAFF APPEARING OR SUBMITTED DURING THE 1981-82 REPORT PERIOD (cont'd)

Irwin, M. E. 1981. Epidemiologia de viruses y micoplasmas en ecosystemas de leguminosas con enfasis en soya. Vol. 3, pages 95-118 in F. Cisneros and E. Trujillo, eds., Curso Internacional de Control Integrado de Plagas. Instituto de Ciencia y Tecnologia Agricolas, Guatemala. 3 volumes.

Irwin, M. E. 1981. El agroecosystema de leguminosas de grano. Vol. 3, article 42, 16p. in F. Cisneros, ed., Segundo Curso Intensivo. Control Integrado de Plagas y Enfermedades Agricolas. La Molina, Peru. 3 volumes.

Irwin, M. E. 1981. Epidemiologia de virus y micoplasmas en ecosystemas de leguminosas con enfasis en soya. Vol. 3, article 40, 20p. in F. Cisneros, ed., Segundo Curso Intensivo. Control Integrado de Plagas y Enfermedades Agricolas. La Molina, Peru. 3 volumes.

Irwin, M. E. 1983. Ecology of soybean pathogens transmitted by insects. In L. D. Newsom, ed., Integrated pest management of insect pests of soybeans. Wiley Interscience Publishers, New York (In press).

Irwin, M. E., F. Avalos, F. Chicoma, J. Chiroque, P. Alcala, and E. Cardenas. 1981. Manejo de plagas en soya en la selva alta de Peru. INIPA (Lima, Peru) Informe Especial 12. 41p.

Irwin, M. E., S. E. Halbert, G. A. Schultz, and R. M. Goodman. 1981. Environmental factors that alter landing rates of aphid species and the subsequent spread of an aphid-borne, nonpersistently vectored virus. International Conference of Plant Virus Disease Epidemiology. Abstracts of papers. July 28-30, 1981:19.

Irwin, M. E., and G. A. Schultz. 1981. Soybean mosaic virus. FAO Plant Protection Bulletin 29:41-55.

Jackobs, J. A., M. D. Staggs, and D. R. Erickson. 1983. International Soybean Variety Experiment, Seventh Report of Results, 1979. International Agriculture Publication, College of Agriculture, University of Illinois at Urbana-Champagn (INTSOY Series Number 24). In press.

Jordan, E. G., Thapliyal, P. N., and J. B. Sinclair. 1982. Incidence of seedborne fungi on soybean cultivars grown in Illinois. Phytopathology 72:1136.

Kampmeier, G. E., and M. E. Irwin. 1981. Flight activity patterns of *Orius insidiosus* (Say) in soybean and corn/soybean acroecosystems. Abstract 163 in Abstracts of submitted papers. Thirty-sixth annual meeting of the North Central Branch of the Entomological Society of America. Columbus, OH. March 17-19, 1981.

Michalski, R. S., J. H. Davis, V. S. Bisht, and J. B. Sinclair. 1982. PLANT/ds.: An expert consulting system for the diagnosis of soybean

APPENDIX 4: LIST OF PUBLICATIONS BY INTSOY STAFF APPEARING OR SUBMITTED DURING THE 1981-82 REPORT PERIOD (cont'd)

diseases. Pages 133-138 in Proc. First European Conf. on Artificial Intelligence, July 16-18, 1982, Orsay, France.

Mueller, J. D., M. N. Cline, J. B. Sinclair, and J. B. Jacobsen. 1982. Effect of three soilborne fungi on apothetical production of *Sclerotinia sclerotiorum*. Phytopathology 72:1138.

Mueller, J. D., J. B. Manandhar, V. S. Bisht, and J. B. Sinclair. 1982. Soybean seed treatments, 1981. Fungicide-Nematicide Tests 37:173.

Rodriguez-Marcano, A., and J. B. Sinclair. 1982. Variation among isolates of *Colletotrichum denatium* var. *truncata* from soybean and three *Colletotrichum* spp. to benomyl. Journal of Agriculture of the University of Puerto Rico 66:35-43.

Schultz, G. A., M. E. Irwin, and R. M. Goodman. Aphid transmission of soybean mosaic virus: Factors affecting virus acquisition and transmission frequency. Manuscript submitted to Annals of Applied Biology.

Schultz, G. A., M. E. Irwin, and R. M. Goodman. 1983. Factors affecting aphid acquisition and transmission of soybean mosaic virus. Annals of Applied Biology. (In press).

Shatla, M. N., and J. B. Sinclair. 1982. Soilborne pathogens and damping-off of soybeans. Pages 126-129 in J. B. Sinclair and J. A. Jackobs, eds., Soybean Seed Quality and Stand Establishment. University of Illinois at Urbana-Champaign, College of Agriculture, INTSOY Publ. no. 22.

Shortt, B.J., B. J. Jackobsen, M. C. Shurtleff, and J. B. Sinclair. 1982. Soybean seed quality and fungicide seed treatment. Pages 408-413 in Thirty-fourth Illinois Custom Spray Operators Training School, Summaries of Presentations. University of Illinois at Urbana-Champaign, Cooperative Extension Service, Urbana.

Shortt, B. J., J. B. Sinclair, C. G. Helm, M. R. Jeffords, and M. Kogan. 1982. Soybean seed quality losses associated with bean leaf beetles and *Alternaria tenuissima*. Phytopathology 72:615-618.

Shurtleff, M. C., B. J. Jacobsen, and J. B. Sinclair. 1982. Fungicides, disinfectants, grain preservatives, surfactants, and soil-disinfesting chemicals. Pages 348-372 in: Thirty-fourth Illinois Custom Spray Operators Training School, Summaries of Presentations. University of Illinois at Urbana-Champaign, Cooperative Extension Service, Urbana.

Sinclair, J. B. 1981. Fungicide sprays for control of seedborne pathogens of rice, soybeans, and wheat. Seed Science and Techology 9:697-705.

APPENDIX 4: LIST OF PUBLICATIONS BY INTSOY STAFF APPEARING OR SUBMITTED DURING THE 1981-82 REPORT PERIOD (cont'd)

Sinclair, J. B. 1982. Compendium of Soybean Diseases. 2nd ed., American Phytopathological Society. St. Paul, MN. 104p.

Sinclair, J. B. 1982. Seedborne microorganisms and viruses and seed quality. Pages 42-45 in J. B. Sinclair and J. A. Jackobs, eds., Soybean Seed Quality and Stand Establishment. University of Illinois at Urbana-Champaign, College of Agriculture, INTSOY Publ. no. 22.

Sinclair, J. B. 1982. Seed pathology - the basics. Proc. Short Course for Seedsmen 21:7-15. (Seed Technol. Lab., Mississippi State, MS)

Sinclair, J. B. 1982. Seed-borne pathogens of irrigated soybeans. Pages 69-72 in W. H. Judy and J. A. Jackobs, eds., Irrigated Soybean Production in Arid and Semi-Arid Regions. University of Illinois at Urbana-Champaign, College of Agriculture, INTSOY Publ. no. 20.

Sinclair, J. B. 1982. New approaches to soybean seed treatment. Search 16:1-16.

Sinclair, J. B., and J. A. Jackobs, eds. 1982. Soybean Seed Quality and Stand Establishment. University of Illinois at Urbana-Champaign, College of Agriculture, INTSOY Publ. No. 22. 206 pages.

Sinclair, J. B., B. J. Irwin, and Wang-jin Ling. 1983. Soybean Research in China and the U.S. Proceedings of the First China/USA Soybean Symposium and Working Group Meeting. International Agriculture Publication, College of Agriculture, University of Illinois at Urbana-Champaign (INTSOY Series Number 25). In press.

Smith, R. S., W. H. Judy, and W. C. Stearn. 1983. International Inoculant Shipping Evaluation. International Agriculture Publication, College of Agriculture, University of Illinois at Urbana-Champaign (INTSOY Series Number 23). In press.

Stannard, L. J., E. J. Armbrust, P. Watson, and M. E. Irwin. 1983. New records of thrips in Illinois. Trans. Ill. Acad. Sci. (In press).

Thapliyal, P. M., M. A. Cubeta, and J. B. Sinclair. 1982. Control of prickly sida plants with *Colletotrichum gleosporoides* in Illinois. Phytopathology 72:1140.

Yeh, C. C., J. B. Sinclair, and A. T. Tschanz. 1982. *Phakopsora pachyrhizi*: Uredial development, uredopsore production and factors affecting teliospore formation on soybeans. Australian Journal of Agricultural Research 33:25-31.

Yeh, C. C., J. B. Sinclair, and A. T. Tschanz. 1092. *Phakopsora pachyrhizi* not transmitted by infested soybean seeds or soil. Soybean Rust Newsletter 5:44-47.

APPENDIX 4: LIST OF PUBLICATIONS BY INTSOY STAFF APPEARING OR SUBMITTED DURING THE 1981-82 REPORT PERIOD (cont'd)

Yorinori, J. T., and J. B. Sinclair. 1982. *Cercospora sojina*: Its relation to defoliation, reduced seed weight, sed infection and with other seedborne pathogens of soybean. Phytopathology 72:173.

Yorinori, J. T., and J. B. Sinclair. 1982. *Cercospora sojina*: A set of differential cultivars for race identification. Phytopathology 72:173.

Zhigang, Xu, J. E. Polston, and R. M. Goodman. Identification of three soybean viruses from the People's Republic of China. In preparation.

Zinnen, T. M. 1982. Thermotherapy of soybean seeds to control seedborne fungi. Phytopathology 72:831-834.

INTSOY Project Staff Assigned to Research Contract AID/TA/C-1294
April 1, 1976 - December 31, 1982

*Name	Rank/Title	Department	FTE
Professional Staff			
Abrams, Raul	Assoc. Director	INTSOY Administration (to 1/31/80)	.25
Bouseman, J. K.	Asst. Entomologist	Ag. Entomology (from 8/21/77 to 8/31/79)	.50
*Bravo, J. A.	Asst. Agronomist	Agronomy (from 12/1/79)	1.00
*Camacho, Luis H.	Research Agronomist	Agronomy (From 8/21/78)	1.00
Chou, Chung-Mei Hus	Asst. Food Scientist	Food Science (from 8/13/79 to 5/15/80)	1.00
Dunker, R. E.	Asst. Agronomist	Agronomy (from 7/1/75 to 9/20/77	1.00
Edwards. S. K.	Asst. Plant Pathologist	Plant Pathology (from 7/13/81 to 7/12/82)	1.00
*Erickson, D. R.	Asst. Agronomist	Agronomy (from 10/8/80)	1.00
Ferrier, L. K.	Asst. Professor	Food Science (from 10/5/77 to 8/20/78)	.75
*Fletcher, Jacqueline	Asst. Professor	Plant Pathology (from 8/21/82)	1.00
*Franklin, K.	Asst. Plant Pathologist	Plant Pathology (from 1/5/81 to 2/20/82))	.35
*Goodman, R. M.	Professor	Plant Pathology (from 8/74 to 9/14/82)	.75
Hill, H. J.	Asst. Agronomist	Agronomy (from 12/1/76 to 9/10/80)	1.00

INTSOY Project Staff Assigned to Research Contract AID/TA/C-1294
April 1, 1976 - December 31, 1982 (cont'd)

*Name	Rank/Title	Department	FTE
Hittle, C. N.	Professor	Agronomy (to 1/9/76)	.25
		(from 8/8/81 to 8/20/82)	1.00
Hruska, Mary C.	Asst. Plant Pathologist	Plant Pathology (from 2/12/80 to 7/20/81)	1.00
*Irwin, M. E.	Assoc. Professor	Ag. Entomology	1.00
*Jackobs, J. A.	Professor	Agronomy (from 8/21/78 to 6/30/80)	.50
		(from 8/21/81)	.75
Judy, W. H.	Assoc. Professor	Agronomy (from 6/1/77 to 3/4/81)	.75
*Kauffman, H. E.	Director	INTSOY Administration (from 12/21/81)	1.00
*Leath, Janet	Asst. Plant Pathologist	Plant Pathology (from 5/17/82)	
*McCowen, T. A.	Asst. Director	INTSOY Administration	.25
Minor, H. C.	Asst. Professor	Agronomy (to 4/17/78)	.75
Nelson, A. I.	Professor	Food Science (8/21/77 to 6/20/78)	.25
Nguyen, Q. N.	Asst. Professor	Agronomy (from 11/13/78 to 3/16/80)	1.00
Oard, J. H.	Asst. Agronomist	Agronomy (from 9/12/78 to 8/10/79)	1.00
*Paris, Georgine P.	Asst. Plant Pathologist	Plant Pathology (from 8/20/82)	1.00
*Polston, Jane E.	Asst. Plant Pathologist	Plant Pathology (from 1/14/80 to 8/20/82)	1.00

INTSOY Project Staff Assigned to Research Contract AID/TA/C-1294
April 1, 1976 - December 31, 1982 (cont'd)

*Name	Rank/Title	Department	FTE
Rodda E. D.	Professor	Ag Engineering (to 8/20/77)	.25
Santas, J. W.	Asst. Professor	Ag Communications (9/17/78 to 3/31/79)	.50
Shock, Theresa L.	Asst. Plant Pathologist	Plant Pathology (from 9/7/76 to 8/20/79)	1.00
*Sinclair, J. B.	Professor	Plant Pathology	.25
Smith, R. Stewart	Asst. Professor	Agronomy (from 6/13/77 to 12/31/79)	1.00
*Stearn, W. C.	Asst. Professor	Agronomy (from 3/21/80)	1.00
Thompson, W. N.	Director	INTSOY Administration (.25 to 9/21/78) (to 12/20/81)	.40
*Wei, L. S.	Professor	Food Science (from 10/21/77)	.25
Whigham, D. K.	Asst. Professor	Agronomy (to 4/11/77)	.75
Support Staff			
Allison, Elizabeth (Schaefer)	Res. Assistant	Ag. Entomology (6/7/76-8/11/78)	1.00
Anderson, Debora	Res. Assistant	Agronomy (5/21/77-8/20/78)	1.00
Appleman, J. D.	Res. Assistant	Food Science (to 11/23/76)	1.00
Baer, K. D.	Res. Assistant	Food Science (to 8/20/78)	1.00
*Bajet, N. B.	Res. Assistant	Plant Pathology (from 8/21/78)	.50
*Bowman, J. E.	Res. Assistant	Plant Pathology (from 8/21/81)	.25

INTSOY Project Staff Assigned to Research Contract AID/TA/C-1294
April 1, 1976 - December 31, 1982 (cont'd)

*Name	Rank/Title	Department	FTE
Bowers, G. R., Jr.	Res. Assistant	Plant Pathology (from 5/21/76 to 8/20/80)	.50
Brinkman, G. S.	Res. Assistant	Plant Pathology (from 5/21/76 to 5/20/79)	.50
Burnsmier, Helen	Clerk III	Agronomy (to 9/30/78)	1.00
*Creswell, J.	Clerk-Typist III	Agronomy (from 3/10/81)	1.00
*Cunningham, Patricia	Clerk-Typist III	INTSOY Administration (1.00 to 9/16/78)	.75
*Datnoff, L.	Res. Assistant	Plant Pathology (from 3/21/81)	.50
Eckenbeck, Susan L.	Res. Assistant	Agronomy (from 7/21/76 to 10/31/77)	.50
Elmore, R. W.	Res. Assistant	Agronomy (from 8/21/78 to 8/20/81)	.50
Endsley, Margaret R.	Clerk-Typist III	Agronomy (to 9/27/77)	1.00
Foor, S. R.	Res. Assistant	Plant Pathology (4/1/77-7/20/77)	.50
Halbert, Susan E.	Res. Assistant	Ag. Entomology (5/21/76-12/20/78 & 9/21/79-11/20/79)	.50
*Hansens, Judy A.	Clerk-Typist III	INTSOY Administration (from 4/24/82)	1.00
*Irvin, Gloria	Clerk-Typist III	Food Science (from 6/3/81)	.50
*Irwin, Bonnie J.	Res. Associate	INTSOY Administration (from 8/21/79)	.50

INTSOY Project Staff Assigned to Research Contract AID/TA/C-1294
April 1, 1976 - December 31, 1982 (cont'd)

*Name	Rank/Title	Department	FTE
*Kampmeier, Gail	Res. Technician	Ag. Entomology (from 7/21/79)	1.00
Kanthamani, S.	Res. Assistant	Food Science (to 11/23/76)	.25
*Kogan, Jenny	Res. Associate	Ag. Entomology (from 1/21/77)	.25
McBroom, R. L.	Res. Assistant	Agronomy (from 8/21/78 to 8/20/80)	.50
McClary, Richard D.	Res. Assistant	Plant Pathology (9/21/77-12/20/78)	1.00
McCune, T. D.	Res. Assistant	Food Science (to 8/20/76)	1.00
Medina-Lopez, F.	Res. Assistant	Ag. Economics (from 7/1/78 to 11/30/79)	.50
Newell, Christine A.	Res. Assistant	Agronomy (to 8/20/77)	1.00
Orf, J. H.	Res. Assistant	Food Science (from 8/17/78-3/1/79)	.50
Orlowski, Janet	Res. Assistant	Food Sciene (from 8/21/78 to 7/21/79)	1.00
Primmer, R. R.	Assistant I	Ag. Engineering (to 4/29/77)	.50
Quarles, D. B.	Res. Assistant	Agronomy (from 6/1/78 to 5/7/81)	.50
Rokke, Douglas L.	Staff Assistant	Ag. Engineering (8/8/77-8/20/78)	.25
Schneider, Barbara L.	Res. Assistant	Agronomy (from 2/1/78 to 8/20/80)	1.00

INTSOY Project Staff Assigned to Research Contract AID/TA/C-1294
April 1, 1976 - December 31, 1982 (cont'd)

*Name	Rank/Title	Department	FTE
Spitz, Martha	Clerk-Typist	Agronomy (from 1/121/79 to 2/6/81)	1.00
*Taeger, Deanna	Secretary	INTSOY Administration (from 12/6/81 to 8/28/82)	.75
Thongmeearkom, P.	Res. Assistant	Plant Pathology (to 8/20/78)	.75
*Toews, Vicki L.	Clerk-Typist III	Plant Pathology (from 5/29/79)	.50
Tucker, Margaret E.	Clerk-Typist III	Food Science (to 5/16/81)	.50
Weger, Laura	Clerk-Typist III	Agronomy (10/5/77 to 12/16/78)	1.00
Yeh, C. C.	Res. Assistant	Plant Pathology (from 1/21/78)	.50

*Served on contract project staff during all or part of the period January 1, 1982 to December 31, 1982.