

AGENCY FOR INTERNATIONAL DEVELOPMENT WASHINGTON, D. C. 20523 BIBLIOGRAPHIC INPUT SHEET	FOR AID USE ONLY <i>cat 37</i>
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1. SUBJECT CLASSIFICATION	A. PRIMARY Agriculture	AF00-0336-G339
	B. SECONDARY Plant production--Oil crops--Soybean--Puerto Rico	

2. TITLE AND SUBTITLE
 Trip reports on soybean cultivation in Puerto Rico

3. AUTHOR(S)
 Goodman, R.M. ; Irwin, M.E.

4. DOCUMENT DATE 1975	5. NUMBER OF PAGES 20p.	6. ARC NUMBER ARC RQ633.34
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7. REFERENCE ORGANIZATION NAME AND ADDRESS
 Ill.

8. SUPPLEMENTARY NOTES (Sponsoring Organization, Publisher, Availability)

9. ABSTRACT

10. CONTROL NUMBER PN-AAC-284	11. PRICE OF DOCUMENT
12. DESCRIPTORS Puerto Rico Soybean	13. PROJECT NUMBER
	14. CONTRACT NUMBER AID/CM/ta-C-73-19 Res.
	15. TYPE OF DOCUMENT

RQ
633.34
G653

TRIP REPORT/PUERTO RICO

AID/CM/Co-C-73-19
7/1/74

Date submitted: February 3, 1975

NAMES: Robert M. Goodman, Assistant Professor, Plant Pathology
Michael E. Irwin, Assistant Professor, Agricultural Entomology

DIV/UNIT: International Soybean Program (INTSOY)

PERIOD OF TRAVEL: Goodman: January 11, 1975-January 18, 1975
Irwin: January 11, 1975-January 22, 1975

ITINERARY:

Goodman and Irwin:

- 1-11 Champaign/Chicago/San Juan
- 1-13 Rio Piedras Experiment Station
- 1-14 Rio Piedras/Isabela Substation
- 1-15 Isabela
- 1-16 Mayaguez, University of Puerto Rico
- 1-17 Mayaguez/Fortuna Substation/Lajas Substation/Mayaguez

Goodman:

- 1-18 Mayaguez/San Juan/Chicago/Champaign

Irwin:

- 1-18 Mayaguez
- 1-19 Mayaguez/Utuado
- 1-20 Utuado/Adjuntas Substation/San Juan
- 1-21 San Juan/Gurabo Substation/San Juan
- 1-22 San Juan/Miami/Chicago/Champaign

For detailed itinerary and notes of interest, see Attachment A.

PURPOSES:

1. To assess the feasibility of using Puerto Rico as a testing ground for in-depth crop protection studies on soybeans grown in tropical and subtropical environments by:
 - a. Meeting entomologists and plant pathologists working in Puerto Rico and discussing their work and interests in order to assess potential cooperation in pest management and disease programs.
 - b. Visiting the various agricultural experiment stations and substations in Puerto Rico in order to assess laboratory, greenhouse, equipment items and field facilities, land availability and professional staff willingness for potential plant protection and pest management programs.
 - c. Assessing areas, preferably substations, where climatic and environmental conditions differ sufficiently to allow a wide degree of latitude in eventual pest management and crop protection programs.

2. To discuss in detail with Dr. E. Hamer Paschal II the INTSOY breeding program in Puerto Rico and needed cooperative work to assure adequate screening of candidate germplasm of virus and insect pest resistance, and to develop plans for evaluation of such resistance.
3. To collect samples of soybean viruses for purification at the University of Illinois at Urbana-Champaign, for eventual serological work in Puerto Rico.
4. To begin an intensive survey of soybean arthropods for inclusion in the INTSOY faunal survey at the University of Illinois at Urbana-Champaign.
5. To discuss with Dr. Julio Bird, Plant Virologist, University of Puerto Rico, Rio Piedras, joint research in soybean virology and whitefly transmission of such viruses.
6. To discuss the details with Dr. Pedro Melendez and Dr. Victorio Garcia of an experiment on field spread of soybean mosaic virus by aphid vectors.

ORGANIZATIONS AND PERSONS CONTACTED:

Professional personnel of the University of Puerto Rico, Rio Piedras Experiment Station, Isabela Substation, Lajas Substation, Fortuna Substation, Adjuntas Substation, Gurabo Substation and Mayaguez Campus; professional personnel of the Public Health Service, San Juan Laboratories; professional personnel of the U.S. Department of Agriculture, Mayaguez Institute of Tropical Agriculture, located near the Isabela Substation; and professional personnel of The Nuclear Research Center, Mayaguez. See Attachment B for detailed listing.

RESULTS/ACCOMPLISHMENTS:

1. Puerto Rico was traversed, most entomologists and plant pathologists on the island were met and fruitful discussions were held concerning crop protection, pest management and availability of time, funds, and energies. All but one of the experimental substations were visited (discussions of facilities and willingness to cooperate are included in the discussion under Attachment A: Detailed Itinerary and Schedule of Activities).
2. A cooperative program to breed disease and insect pest resistance into soybeans adapted to tropical and subtropical environments was initiated by Dr. E. Hamer Paschal II, Dr. Robert M. Goodman, Dr. Pedro Meléndez, Dr. Victorio García, and Dr. Michael E. Irwin. This program will incorporate germplasm already screened for resistance to diseases and to insect defoliators--and possibly a line resistant to stink bugs--into lines agronomically suited for the tropics and subtropics.
3. Samples of several viruses attacking soybeans at the Isabela and Lajas substations were collected. These will be characterized, purified and used to produce antiserum for serological detection work in Puerto Rico and elsewhere.
4. Two collections of insects in soybean fields were made, one at the Isabela Substation and one at the Lajas Substation. Relatively few insects were obtained, principally because the fields were sprayed with insecticides on a weekly basis. Most notable was the almost total lack of parasites and predators.

5. We had an extensive and productive discussion with Dr. Julio Bird concerning viruses transmitted by whitefly vectors. Dr. Bird expressed a willingness to cooperate in areas of virology and vector transmission with the INTSOY virologist and entomologist.
6. An experiment on field spread of soybean mosaic virus by aphid vectors was discussed in detail. The experiment will be conducted in collaboration with Dr. Pedro Meléndez, Dr. Victorio García and Mr. Curt Nissly on a one-half-acre plot at the Isabela Substation.

FOLLOW-UP ACTION REQUIRED:

1. Return to Puerto Rico in late February to supervise the plot design and help plant the soybeans for the experiment on field spread of soybean mosaic virus by aphid vectors.
2. Dr. R. M. Goodman should return to Puerto Rico with samples of virus antisera and other materials in order to perform preliminary serological tests on virus-infected soybean tissue to assess the actual and relative importance of various viruses in soybean plantings on the island.
3. Dr. Bird will send tissue infected with *Rhynchosia* mosaic virus to Urbana as soon as the whitefly culture in his greenhouse recovers from a low population ebb to allow transmission work. In Urbana this virus will be used for characterization and antiserum production studies.
4. On a future trip, the Corozal Substation should be visited since it is supposed to have a small soybean plot. This substation should be visited by Dr. M. E. Irwin and Dr. R. M. Goodman.
5. Dr. M. E. Irwin should, on a future trip to Puerto Rico, meet and discuss entomological problems with Dr. Mario Perez, Acting Director of the Agricultural Experiment Station.
6. The San Juan Laboratories, Public Health Service, has been monitoring habits and diseases of a group of people on the island for about ten years. The monitoring has been detailed and fairly complete. It would pay INTSOY to investigate the types of data being monitored and, if nutritional data are included, a potential area of marketing psychology may be open to pursue.
7. Mr. Sylvario Medina G. is interested in the taxonomy and bionomics of Thysanoptera (thrips). Dr. Lou Stannard of the Illinois Natural History Survey is also interested in Thysanoptera systematics and bionomics. INTSOY entomologists should approach both entomologists and encourage a joint project on the bionomics and systematics of Thysanoptera on soybean and related legumes in Puerto Rico.
8. Mr. Michael Primiani, now at the Rio Piedras Experiment Station recently received his M.S. from the University of Connecticut. His interests are in biological control and predation. He is also working on *Liriomyza munda* (Diptera: Agromyzidae)--the leaf miner--on edible legumes. INTSOY should encourage him to (1) carry out experiments on leaf miners on soybeans, continue his interests in biological control and predation and deal with the soybean crops, and (3) cooperate actively and extensively in a pest management program on soybeans in Puerto Rico.

9. Dr. Rafael Perez Perez of the Fortuna Substation has had excellent training at L.S.U. under Dr. Newsom. He is the entomologist at Fortuna and is without a laboratory. He is eager to do some meaningful work in pest management and should be encouraged to cooperate with INTSOY in a pest management program at Fortuna.
10. Much enthusiasm exists among the staff at the Adjuntas Substation. Funds are low and there is a dearth of professional personnel, especially in crop protection. As soon as Dr. Meléndez and Dr. García begin their disease nursery at Adjuntas, INTSOY should allocate funds for weekly sampling of the plots for soybean insects. Irwin could train the personnel to sample the fields in a useful way.
11. There is an abundance of the Bean Leaf Beetle, Cerotoma ruficornis, at the Lajas and Fortuna substations. The adults of these beetles defoliate soybeans and sometimes act as vectors of viral diseases. The larvae feed on roots and nodules of soybeans and other edible legumes. An intensive survey of the eggs and larvae of this beetle seems an excellent first step in its eventual control under a pest management scheme. Dr. Waldbauer and Dr. Kogan have devised a sampler for Cerotoma eggs.
12. The most obvious insect pest of soybeans seen at both the Isabela and Lajas substations was the Pega-Pega, Hedylepta indicata (Lepidoptera: Pyralidae). The life history and bionomics of this species needs intensive study. I suggest an entomology graduate student at the University of Puerto Rico take on the study as a dissertation problem.
13. Dr. Carlos Cruz, Isabela Substation, would like INTSOY to provide a synoptic collection of named soybean arthropods from Puerto Rico. This collection would be housed at the Isabela Substation and used as a basis for identification of the common arthropods associated with soybeans.
14. Information on soybean germplasm from Indonesia that is resistant to stink bugs should be sent to Dr. E. Hamer Paschal.
15. Give a series of seminars (Irwin) on pest management and biological control to the entomology group at the University of Puerto Rico, Mayaguez Campus.

OTHER REMARKS:

The initial and major purpose of the trip for the entomologist (Michael E. Irwin) was to assess the feasibility of using Puerto Rico as a major testing ground for in-depth pest management studies on soybeans grown in tropical and sub-tropical environments. The purpose is central and some discussion pointing to its clarification is needed.

Advantages of working in Puerto Rico

1. Close to Urbana by air--one day.
2. Puerto Rico has a series of experimental substations which represent a wide variety of climatic situations likely to be encountered in the subtropics and tropics.
3. Land and some equipment are available at these substations.

4. Experienced professionals in related disciplines are present on the islands: Dr. Meléndez, Dr. García, Dr. Bird (Pathology), Dr. Riveros (Weed Science), Dr. Abrams (Agronomy), Dr. Beinroth (Soils), Dr. Marcial Rico (Lajas), Frank Julia (Isabela), and others. These professionals are all willing to cooperate in pest management schemes.
5. Experienced professional entomologists in related crop areas are present on the island: Dr. Cruz, Dr. Perez, Mr. Medina, Mr. Primiani, Dr. Walker, Dr. Kuno and others.
6. University of Illinois INTSOY personnel are actively working on various aspects of soybean production and protection in Puerto Rico. Of particular importance are: Dr. Hamer Paschal, Plant Breeder and Dr. Robert Goodman, Virologist.
7. The INTSOY entomologist in charge of pest management studies, Dr. Michael Irwin, is actively cooperating in virus-vector work with Dr. Goodman and in screening germplasm for pest resistance with Dr. Paschal.
8. INTSOY is a cooperative program between the University of Illinois and the University of Puerto Rico.
9. Puerto Rico is an oceanic island and therefore depauperate in its faunal complement. The soybean ecosystem is likely to contain fewer pests and fewer beneficial insects than one would expect on the mainland at a comparable latitude. During the initial phases of a pest management program, it allows the entomologist to focus on existing pests and their bionomics and economic injury levels. Eventually, any pest management programs for mainland tropics would have to be refined because of the existence of a more complex situation with a greater number of species interactions.

Disadvantages of working in Puerto Rico

1. There are no professional entomologists working on a soybean pest management program in Puerto Rico at this time. Even though the University of Puerto Rico INTSOY and 211(d) programs are heavily committed to crop protection, they have not hired an entomologist for their staff; no mention of entomology was evident in the latest Annual Report.
2. Almost all of the professional entomologists in Puerto Rico are over-committed to several projects. It would be difficult to free one sufficiently in order to allow him to work solely or primarily on pest management for soybeans.

Conclusions

1. In order to initiate and sustain a viable, in-depth pest management program in Puerto Rico, one full-time professional entomologist is highly desired.

2. A full-time technician to assist the pest management and crop protection programs is also highly desired. This technician would be directly under the supervision of the professional entomologist; in the event the latter position is not filled immediately, the technician is needed anyway. In the absence of an INTSOY entomologist stationed in Puerto Rico, the technician would be supervised by INTSOY crop protection personnel at Illinois with the cooperation of Dr. Paschal, Dr. García and Dr. Meléndez. His assignments would include making regular collections of insect pests, maintaining experiments and making the regular observations that they require, assisting Dr. Paschal in disease and insect resistance studies, and in general enabling INTSOY virology and entomology studies to continue throughout the year. This is a top priority in our view.

3. INTSOY professional personnel stationed at the University of Illinois, at least the entomologist and virologist, should endeavor to spend a growing season every year or two in Puerto Rico, during which field experimentation could be greatly intensified.

Therefore, it is our general conviction that a viable pest management program can and should be initiated in Puerto Rico.

ATTACHMENTS:

Attachment A: Detailed Itinerary and Schedule of Activities.

Attachment B. Organizations and Persons Contacted.

ATTACHMENT A: DETAILED ITINERARY AND SCHEDULE OF ACTIVITIES

January 11, 1975

By car from Champaign Illinois at 5:30 a.m. to Chicago. By plane from Chicago to Miami to San Juan.

January 13, 1975

By car to the Public Health Service, San Juan laboratories. We were given a tour of the facilities by Dr. Chester Moore, Medical Entomologist. We were introduced to the Chief of the Laboratory, Dr. Barney Cline and to the sanitary engineer and epidemiologist, Sr. Ernesto Ruiz. The laboratories were well equipped with map room, rearing rooms for mosquito and snail culture, virology, and tissue culture rooms. Modern equipment was in abundance and there was a genuine willingness on the part of the Chief and others to lend assistance to INTSOY if and when the need arises.

The laboratory has been monitoring a sector of the human population on the island for about ten years in very great detail, especially with respect to schistosomiasis.

By car to the Rio Piedras Experimental Station. At Rio Piedras, we saw Dr. Pedro Meléndez from the Mayaguez campus and were introduced to Dr. Julio Lopez Rosa, Head, Department of Botany and Phytopathology. We had a constructive conversation about the organization of the experiment station and its various substations. Dr. Julio Bird was not in, so we next visited the entomology department and discussed entomological problems with Sr. Sylvario Medina G., (MS, Iowa State University), acting head, Department of Entomology and Mr. Michael Primiani, Entomologist. The facilities of the entomology section are poor and the funds for their improvement are impossible to obtain. There is a small insect collection, but not well curated because of lack of funds and assistance. Sr. Medina is interested in the systematics of Muscidae (Diptera) and Thysanoptera (thrips).

Mr. Michael Primiani (MS., University of Connecticut) has only been with the University of Puerto Rico for seven months. His major interests lie in biological control and the phenomenon of predation. He has begun an experiment on the favored hosts, damage caused to these hosts, parasites and predators of the leaf miner, *Liriomyza munda* and other Agromyzidae (Diptera), especially those attacking legumes. He initially will be using cowpeas and various varieties of snap beans. At this point he does not plan to include soybeans in his test plots.

We also visited with Dr. L. J. Liu, plant pathologist on sugar cane and other crops. His laboratory was well organized and well supplied with basic equipment and ample chemicals.

The library at Rio Piedras is adequate, containing most of the major journals on economic aspects of virology and entomology. An electron microscope is now being installed at Rio Piedras.

January 14, 1975 a.m.

Returned by car to the Rio Piedras Experiment Station. We talked at length to Dr. Julio Bird, plant pathologist, and discussed details of whitefly transmitted virus work he was conducting, some of which concerned soybeans. He showed us his

greenhouse and field facilities, and we were able to see virus symptoms in several types of plants. Dr. Bird is genuinely willing and eager to cooperate in studies on the whitefly--transmitted viruses that infect soybeans.

January 14, 1975 p.m.

By car from Rio Piedras to Isabela. Visited the USDA field adjacent to the Isabela Substation and discussed disease and insect problems on beans with Dr. Nader Vakili and Dr. George Freytag, plant breeders. We also met Mr. Curt Nissly, soybean breeder and student of Dr. Carl Hittle, at Isabela. We discussed plans for seeing the entire Isabela Substation in the 15th with Dr. Raul Abrams, Curt Nissly, and Frank Julia.

January 15, 1975

By car to Isabela. Toured the Isabela Substation facilities. Meteorological station recording devices include: max-min temperature, hygrothermograph, max-min temperature three inches below ground surface, solar radiation, wind velocity, evaporation and rain gauges.

Greenhouse facilities minimal, one nearly empty but without air-conditioning. Nursery facilities for germination good; several sheds for large equipment storage. A new unit is being built for seed storage of breeding germplasm for Dr. E. Hamer Paschal.

The substation had field experiments in soybeans, cowpeas, pigeon peas, yams, papaya, and other crops. A citrus collection was present.

Dr. Carlos Cruz, Entomologist, University of Puerto Rico, Dr. E. Hamer Paschal, Plant Breeder, University of Illinois, Mr. Jose Bravo, Assistant Plant Breeder, Iowa State University, Mr. Curt Nissly, University of Illinois Graduate Student, and Mr. Frank Julia, Agronomist, University of Puerto Rico, showed us the soybean plots.

Entomological problems were as follows: both the lesser green stink bug, Thyanta perditor, and the southern green stink bug, Nezara viridula, were present. Frank Julia thought that the lesser green stink bug caused more severe damage last year; Hamer Paschal thought the southern green stink bug was the major problem.

A complex of leaf tiers, called "Pega-Pega" is another serious pest. They include Hedylepta indicata and possibly Herpetogramma bipunctalis, the southern beet webworm. I saw no parasites on them.

Bean leaf rollers (Urbanus proteus) are present but in low numbers. For the most part the fields were clean but spotty infestations of mites were noted.

A membracid, Umbonia crassicornis, was recently introduced into Puerto Rico from Florida or Mexico. It feeds on legumes and has become a serious pest of Jacaranda trees. It has moved into pigeon peas and a few specimens were seen on soybeans. It would pay to keep a close watch on this species.

A sample of soybean insects were taken at the Isabela Substation. It should be noted that there were very few beneficial insects observed in the soybeans; there was a complete lack of the predator complex--except Chrysopa (Neuroptera)--and almost no parasites. This is probably due to a weekly spraying with Diazinon.

Diseases generally were not prevalent but an unidentified leaf spot disease was found in some of the Iowa State plantings and occasionally in areas planted by Curt Nissly. The lesions were grossly similar to bacterial pustule lesions but pustules were not seen and the necrotic area was surrounded by a chlorotic halo. Infection by Pseudomonas tabaci and the bacterial pustule organism may be the cause, but the chlorotic areas were not as discrete as is usually found in the wildfire disease. Isolations by Dr. Meléndez and Dr. García are underway to determine the organism responsible for this disease.

Extensive rugosity in Hill soybean seedlings grown from seeds increased at Isabela last summer was found in a variety trial planted by Curt Nissly. Unfortunately the leftover seeds had been discarded, but Nissly has been asked to retain seeds collected from infected plants now in the field for later study. In three of four replicated plots, the effect was present in 100 percent of the plants; plants in the fourth plot were affected only at one end. Soybean mosaic virus is a possible explanation but its distribution and less than typical symptom pattern makes Goodman doubt that soybean mosaic virus is involved. Results of tests completed by the submission date of this report show that these plants were not infected with soybean mosaic virus.

Occasional stunted plants, with misshapen leaves and sinuous leaf veins were found in Jupiter and certain other varieties. These may be plants infected with whitefly-transmitted pathogens, or doubly infected with other soybean viruses. The symptoms were not typical of those seen in the field on an earlier trip (August 1974) or those illustrated by Dr. Bird as being caused by Rhynchosia mosaic virus.

January 16, 1975

By car to Mayaguez, University of Puerto Rico. Spent the morning with Dr. E. Hamer Paschal. Our discussions included:

Lines resistant to defoliators, especially Mexican bean beetle: lines 171451, 227689, and 229358. Original selections made by Dr. John van Duyn, South Carolina. All these are late maturing but agronomically unsuitable--much lodging, etc. However, levels of resistance to the Mexican bean beetle and other defoliators are outstanding.

These resistant lines have been crossed with Bragg--maturity Group VII-- by Dr. Maxwell of South Carolina. The first two lines were eventually dropped, and the Bragg x 229358 is now undergoing its F7 generation with a couple of back crosses. At present the cross is being advanced in Brazil. Enough seed should be available for Dr. E. Hamer Paschal to begin a program in Puerto Rico with very advanced germplasm. I will endeavor to get some seeds for Dr. Paschal while in Brazil. Line 171451 was crossed with Williams (Group III) but it is not as advanced as 229358 x Bragg. Dr. Paschal wants advanced seed plus seed from original lines. The Williams x 171451 is showing good resistance to the velvet bean caterpillar and I will attempt to get some seed of it.

There is a report of a line resistant to stink bugs from Indonesia.

We talked of possible methods of bioassaying resistance to insects and diseases, and we have some agreement on plot design and trial areas.

Initially Isabela and Lajas provide good testing sites, but Adjuntas and Fortuna should also be used at a later, more advanced stage. Fortuna Substation may be especially favorable for certain kinds of virus-vector tests, since disease problems are minimal but aphids are prevalent. Thus studies in which plants must be inoculated with single pathogens may be best done at the Fortuna location.

In order to bioassay germplasm for pest resistance, a good population of the pest is necessary. In most cases, this can be accomplished by interplanting with snap beans (Phaseolus vulgaris). The snap bean is favored over soybean, germinates sooner and dies sooner. The large populations that build up on the snap bean move to the soybean and susceptible versus resistant germplasm can be observed. A good field design is to plant potentially resistant lines (2 rows) and a susceptible parent line (1 row) in a continuous fashion, with snap beans randomly in all rows. Evaluating lines can be done on damage caused or on number of pests found. Usually, with defoliators, it is easier to estimate defoliation, and with stink bugs to estimate damage to seed, than to estimate numbers of insects per foot of row. A similar design based on the use of virus inoculated spreader plants with snap beans to attack vectors before soybeans are planted could be used to assure adequate field spread of viruses for resistance screening.

Hamer Paschal, Bob Goodman and Mike Irwin are planning to tour the southern U.S. soybean area sometime this fall, probably between late August and early September.

By car to the Entomology Research Laboratory of the Biology Department, College of Arts and Sciences, University of Puerto Rico, Mayaguez Campus. Dr. Flavio Padovani, head of the laboratory, was not there. Some of his work deals with artificial diets for the stink bug, Solubea Pugnax.

Dr. Goro Kuno, Insect Pathologist of the Entomology Research Laboratory, was available and we had a productive discussion. Some of the excerpts: (1) Dr. Kuno has worked somewhat with microsporidians of the lepidopterous pest, Spodoptera. He has sent samples of microsporidians to Dr. Wayne Brooks of South Carolina State. He has also found microsporidians in the sugar cane borer and in mosquitoes of the genera Culex, Aedes and Anopheles. In Gainesville, Dr. Edward Hazzard seems interested in identifying microsporidians for Dr. Kuno. Dr. Joe Maddox, Illinois Natural History Survey, would also be willing to identify microsporidians from nonmosquito hosts for Dr. Kuno. (2) Dr. Kuno has worked on the histopathology of the nuclear polyhydrosis virus in Heliothus. (3) Dr. Kuno is beginning a study of tissue culture of mosquitoes and is interested in replication of insect viruses. There is some evidence that molecules are released by mosquitoes under autocidal stress which tend to trap or kill virus, which initiated the stress in the first place. He is interested in the physiological affect on the cells. (4) Dr. David Walker, now with the Nuclear Center, is moving over to the Entomology Research Laboratory and will be heading up a project on rice insects. He has worked on resistance to insects in soybeans.

The Entomological Research Laboratory is fairly well equipped: ultra-centrifuge, scanning electron microscope, infrared spectrometer, two gas chromatographs, incubators, good balances and several environmental chambers (one of which is a large walk-in type and lacks about \$3,000 of being properly installed), insects cages, etc. Dr. Walker has developed artificial diets for

the sugar cane borer, Spodoptera, Heliothus, Garia melinara, and these are available also. For long-term cooperation with personnel of the ERL, Dr. Kuno suggests we formalize an arrangement with Dr. Rodriguez Flores, Faculty of Arts and Sciences, Office of Dean, University of Puerto Rico, Mayaguez. For short-term cooperation and occasional use of their equipment, he suggests no formal arrangements are necessary.

We met the Cornell University International Agriculture class group led by Dr. David Thurston, Plant Pathologist and Dr. Loy Crowder, Plant Breeder. That evening, Dr. Nolla, Plant Pathologist (retired), University of Puerto Rico, hosted the Cornell group; we were also invited. Illustrated lectures were included in the program: edible legume and soybean diseases presented by Dr. Pedro Meléndez and breeding for flower diversity in Amaryllis lilies presented by Dr. Nolla.

January 17, 1975 a.m.

By car with Dr. E. Hamer Paschal and Curt Nissly from Mayaguez to the Fortuna Substation east of Ponce. There we met with Dr. Rafael Perez Perez, Entomologist, University of Puerto Rico. Dr. Perez received his Ph.D. under Dr. Newsom, Louisiana State University. The edible legume plots set up by Dr. Vakili proved interesting. Cerotoma was prevalent, but the leaf tiers and leaf rollers were not major problems, at least in snap beans. There were three species of lepidopterous pod borers in the pigeon peas which presented a serious problem. A few southern green stink bugs were found and no beneficial insects were observed. These plantings were essentially free of diseases.

The substation occupies 250 to 300 acres of good, clay loam soil, most of which is flat or slightly rolling. There were no laboratory facilities available, but greenhouses were present and an adequate weather station existed. Rainfall is low, 30 inches per year, most of which falls in June, July and August. Irrigation facilities are available, supplied by two deep wells.

The citrus collection has been neglected lately. The major crops of the substation are: sugar cane, mangos, avocados, guavas, other tropical fruits, onions, and now edible legumes.

Water is the limiting resource of the substation. Because of the dry climate, the area is relatively free of fungal and bacterial diseases. Insects abound because of the dry, hot climate. Fortuna is a must for eventual inclusion in a pest management program on soybean in Puerto Rico.

The lesser cane borer, Elasmopalpus, and the melon worm, Diaphania hyalinata were severe pests this past season. Dr. Carlos Cruz, from the Isabela Substation, has three cabbage plots at Fortuna, one of which was completely destroyed by the diamond back moth.

January 17, 1975 p.m.

By car to the Lajas Substation from the Fortuna Substation. We observed the INTSOY trials, talked with Sr. Renaldo Irezarry, assistant to Dr. M. Rico, Plant Horticulturist, University of Puerto Rico, and made a collection of soybean insects from the INTSOY trials. The soybeans were in late pod set and looked in good condition. There was a high incidence of mites and Cerotoma, and varieties Bossier and Davis were very susceptible to Paga-Paga (Hydelepta indicata). The number of beneficial insects was low; a few spiders and an occasional Nabis sp. (Nabidae) were noted. The trial was sprayed weekly with Diazinon.

By car to Mayaguez.

January 18, 1975

R. M. Goodman: flew Mayaguez/San Juan/Chicago/Champaign.

M. E. Irwin: At Mayaguez.

In the evening, Dr. C. Moore, Public Health Service, San Juan Laboratories, who still has his house in Mayaguez (he was formerly on the staff of the Department of Biology, Entomology Research Laboratory, Mayaguez) invited us to a small party. He invited the entomologists of the area. Unfortunately several were unable to come, but two did: Dr. Goro Kuno and Dr. David Walker. Dr. Walker is interested in induced insect sterility which he claims is related to fatty acid content of insects. He mentioned that he has a proposal submitted to study rice insects. He is interested in host plant attraction with steroids and has worked with cistosterol in snap beans, especially as it relates to the southern cowpea weevil, Caleodermes ? on bean pods.

Upon inquiring into entomological courses offered at the University of Puerto Rico, it came to my attention that there were no courses offered in pest management or biological control. Irwin was asked if he would give some seminars on these aspects in the future. He accepted.

The Nuclear Center has an atomic absorption spectrometer.

January 19, 1975

Mayaguez to Utuado by car.

January 20, 1975

By car from Utuado to the Adjuntas Substation. The substation is located on Route 525 just west of Km. 2.6. It contains 183 acres of heavy clay soil, most of which is rolling or steep. There are three professional agronomists on the staff: Ramon Bosque, head of the substation, Carlos Torres and Elvin Boneta. The weather station at Adjuntas Substation has been maintained for over ten years. Rainfall is high, over seventy inches per year, with a dry spell during January, February, and March. A hotel is available at Adjuntas, 45 minutes by car from the substation. This could possibly serve as a base while working at the substation. The hotel is "Monte Rio."

Mr. Torres gave an extended tour of the grounds and facilities. The main crops are coffee, citrus, and plantain. Facilities at the Adjuntas Substation are as follows: almost no laboratory space, two greenhouses without temperature control (at this elevation, temperature control is not necessary). One of the greenhouses is vacant. Adequate culture beds for certain types of experiments. The weather station has wind, max-min temperatures, humidity and evaporation.

Coffee is grown throughout the central cordillera and the Adjuntas Substation germinates approximately 150,000 seedlings per year for sale to local growers. These are sold very reasonably. Normal planting in Puerto Rico has 1,000 coffee plants per acre.

The coffee leaf miner is the most serious insect pest on coffee and, according to Mr. Torres, is controlled by the insecticide Disyston. One of the most serious diseases of coffee is Cercospera, and Dr. Lopez Rosa along with Mr. Torres is conducting an experiment on Cercospera infestation. There is a serious fungus pest of coffee in Brazil--Ermilaya batraticis--which so far is not a pest in Puerto Rico. Resistant varieties are being vegetatively propagated in the greenhouse in case the fungus gets to Puerto Rico.

Bananas and plantains are also grown in large numbers. The most serious pests are root nematodes which are controlled by the compound Dasanet. Aldrin dip is used for a treatment of plantain borer (beetle) in order to keep it from attacking the rootstock.

Citrus is planted extensively on the substation but the citrus collection has recently been neglected--lack of funds. There are experiments on the Chironja clone, on herbicides on the Valencia orange and others. One experiment deals with shading coffee with plantain. Yield effects are being studied.

Irrigation is available at the Adjuntas Substation. Laborers begin work at 7:00 a.m., professionals at 7:30 a.m. Work ends at 4:00 p.m.

Dr. Vakili will initiate an edible legume project at the substation during late January. Dr. Meléndez and Dr. García have plans for a soybean disease nursery at the substation.

A few snap beans are interplanted in the citrus area of the substation. They appear to be heavily attacked by a fungal or bacterial disease and somewhat chewed up by a chrysomelid beetle, but not the common Cerotoma.

By car to San Juan via Ponce, Salinas, Cayey and Cagua.

January 21, 1975

By car from San Juan to Gurabo Substation near Cagua. Gurabo Substation has 485 acres, of which 250 are devoted to dairy husbandry. About 70 acres are currently unused. All the acreage has built in irrigation facilities. The soil is Mabi clay, a fairly light clay and the ground is fairly level. The substation averages 70-80 inches per year rainfall. Meteorological recordings date back about 20 years and include evaporation, wind velocity, rainfall, humidity, soil radiation, and max-min temperature. There are several greenhouses, one a quarantine facility for newly imported lines of sugar cane.

Although dairy cattle is the main industry at the substation, certain crops are grown: tobacco, sugar cane, plantain, guava, rice, and the root crop yautia (Xanthosoma sp.):

Rice production and feasibility studies are being conducted by the USDA. All other research is through the Agricultural Experiment Station, University of Puerto Rico.

The plantain project involves breeding resistance to the root knot nematode and also screening for the effect of nematocides. The tobacco project deals with breeding filler tobacco and solar energy drying barns are on the substation. Tobacco has many insect and disease problems, but these occur mainly after the beginning of February. The papaya project deals with breeding. A single variety,

8-65, that was left standing was heavily infested with diaspidid scales on the stem and buncy top virus in the crown. Guava variety testing for agronomic characteristics is underway at the Gurabo Substation.

The possibility of cooperation between the staff of the Gurabo Substation and INTSOY pest management is good, but expertise is spread thinly and no pest management scheme could be carried out at the substation without an active INTSOY entomologist stationed on the island. The pests at the Gurabo Substation would probably not differ greatly from those at the Adjuntas Substation, and the Adjuntas Substation seems a better choice for such a scheme from the logistics viewpoint as it is closer to Mayaguez.

Two possible plot sites for soybeans were discussed with Sr. C. Ortiz, Assistant Administrator of the Gurabo Substation: plot 7 for large acreages and plot 19 for small acreage. In the event of future use, plot 19 would be best for pest management studies, primarily because it is closer to the headquarters and has an excellent soil.

According to Sr. H. Cestero, Administrator of the substation, all projects must include a cooperator within the University of Puerto Rico system and must be submitted to the Director of the Agricultural Experiment Station, Dr. Mario Perez (acting) or the Dean of Agriculture, Mayaguez.

By car from Gurabo Substation to San Juan.

January 22, 1975

By car to San Juan airport. By plane San Juan/Miami/Chicago. By car Chicago/Champaign, arrive in Champaign 7:15 p.m.

ATTACHMENT B: ORGANIZATIONS AND PERSONS CONTACTED

University of Puerto Rico

Experiment Station, Rio Piedras

Dr. Julio Lopez Rosa, Head, Department of Botany and Phytopathology
Dr. Pedro Meléndez, Plant Pathologist visiting from the Mayaguez campus
Dr. L. J. Liu, Plant Pathologist
Dr. Julio Bird, Plant Virologist
Sra. Josefina Sanchez, Plant Virology Assistant
Ing. Sylvario Medina G., Acting Head, Department of Entomology
Mr. Michael Primiani, Entomologist

Experiment Substation, Isabela

Dr. Raul Abrams, Head, Department of Agronomy & Associate Director, INTSOY
Dr. Carlos Cruz, Entomologist
Sr. Frank Julia, Agronomist
Mr. Curt Nissly, INTSOY graduate student
Dr. E. Hamer Paschal II, Plant Breeder, University of Illinois
Ing. Jose Bravo, Assistant Plant Breeder for Dr. Walt Fehr, Iowa State University
Mr. Michael Primiani, Entomologist visiting from Rio Piedras
Sr. Luis Ortiz, Administrator and Agronomist
Experiment Substation, Lajas

Sr. Renaldo Irezarry, Assistant to Dr. M. Rico, Plant Horticulturist

Experiment Substation, Fortuna

Sr. Anibal Torres, Horticulturalist and Administrator in Charge
Dr. Rafael Perez Perez, Entomologist

Experiment Substation, Adjuntas

Sr. Ramon Bosque, Administrator and Agronomist
Sr. Carlos Torres, Agronomist
Sr. Elvin Boneta, Agronomist

Experiment Substation, Gurabo

Sr. Herman Cestero Hernandez, Administrator and Dairy Husbandry
Sr. Cesar A. Ortiz Lugo, Assistant Administrator and Plant Breeder
Sr. Teh-ling Chu, Plant Breeder
Sr. Jenofonte L. Serapion, Plant Breeder
Sr. Felipe Roman Garcia, Dairy Husbandry

Mayaguez Campus

Dr. Pedro Meléndez, Plant Pathologist
Dr. Victorio García, Plant Pathologist
Dr. Fred Beinroth, Soil Scientist
Dr. E. Hamer Paschal II, Agronomist, Plant Breeder, University of Illinois
Dr. Goro Kuno, Insect Pathologist
Dr. David Walker, Entomologist (also with the Nuclear Center)
Dr. Nolla, Plant Pathologist (retired)
Dr. Loy Crowder, Plant Breeder, visiting from Cornell University
Dr. David Thurston, Plant Pathologist, visiting from Cornell University

ISDA

Mayaguez and Isabela

Dr. Nader Vakili, Plant Breeder
Dr. George Freytag, Plant Breeder

Public Health Service

San Juan Laboratories

Dr. Barney Cline, Chief
Dr. Chester Moore, Medical Entomologist
Sr. Ernesto Ruiz, Sanitary Engineer and Epidemiologist

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TRIP REPORT/PUERTO RICO

Robert M. Goodman, Assistant Professor of Plant Pathology

DIV/UNIT: INTSOY

DATE SUBMITTED: 24 March, 1975

DATES OF TRAVEL: 22 February to 2 March, 1975
(Detailed itinerary at end of report.)

PURPOSES:

1. Lay out and plant a one-half-acre field experiment at the Subestacion de Isabela.
2. Collect virus-infected tissue from soybean plantings at the Subestacion de Isabela and perform serological tests to identify the viruses present.
3. Continue occasional collection of samples of tissue showing severe virus symptoms for identification and characterization at UIUC.

ACCOMPLISHMENTS:

1. A one-half-acre field was hand planted with Williams soybeans in a 4 x 4 plot design, each plot 30 feet square with sixteen 30-foot rows spaced two feet apart. Each plot is bordered by eight feet of fallow, and the entire experiment is surrounded by three border rows of Williams soybeans. The land preparation was done through the cooperation of Luis Ortiz, Administrator Subestacion, and the planting by R. M. Goodman, M. E. Irwin, and E. H. Paschal with assistance of C. Nissly.
2. I made collections of severely infected soybean tissue from plants grown by Curt Nissly. These included samples from plants heavily infested with Cerotoma trifurcata and adjacent to a field of cowpeas that had earlier been found to be 100 percent infected with a severe strain of cowpea mosaic virus. Serological tests with antisera brought from UIUC were made in the laboratory of Drs. Pedro L. Meléndez and Victorio García. Results showed that plants with a wide range of symptoms, from mild yellow mottle to severe rogose mosaic, were infected with soybean mosaic virus. No evidence of cowpea mosaic, bean yellow mosaic, bean pod mottle, or tobacco ringspot viruses was found in these tissues. Several severely dwarfed plants with severely rugose leaves gave negative reactions in all tests.
3. Collections were made from soybeans planted at Subestacion de Isabela, as they have been on previous trips, for infectivity tests and characterization at UIUC. Tissue from diseased plants that gave no serological reaction was sampled, as was tissue from SMV-infected plants that had symptoms unusually severe for SMV alone.

DETAILED ITINERARY:

22 February Flew CMI/ORD/SJU/MAZ

23 February Personal time off. Checked into hotel at Quebradillas.

- 24 February Quebradillas to to Isabela by car. Spent entire day in field at Subestacion de Isabela.
- 25 February Spent entire day in field at Isabela.
- 26 February Drove M.E. Irwin to Mayaguez Airport. Checked into Hilton Hotel, Mayaguez. Spent remainder of day in laboratory of Dr. P. L. Meléndez.
- 27 February Spent most of day at Dr. Meléndez's laboratory. Attended seminar by Ms. Yvonne Shattuck Villamarzo entitled "Combate quimico del anublo pulverulento en frijol (Vigna Sinensis) en Puerto Rico." Visited briefly with Dr. Goro Kuno, Insect Pathologist in the Entomology Research Laboratory, and with Dr. Paul Powell, Mycologist in the Tropical Mycology Laboratory.
- 28 February Completed serological tests in laboratory at Mayaguez. Drove to Subestacion de Isabela to collect samples. Met Dr. Lidy Lopez, Estacion Experimental Agricola, Rio Piedras and discussed procedures for approval of INTSOY experiments at the substations. Returned to Mayaguez. Flew to SJU.
- 1 March Personal day off.
- 2 March Flew SJU/ORD/CMI.

TRIP REPORT/PUERTO RICO

NAME: Robert M. Goodman, Assistant Professor of Plant Pathology

DIV/UNIT: International Soybean Program (INTSOY) **DATE SUBMITTED:** 24 March, 1975

DATES OF TRAVEL: 11 March to 14 March, 1975
(Detailed itinerary at end of report.)

PURPOSES:

1. To thin, and if necessary rogue, plants in the SMV field experiment planted 25 February 1975.
2. To inoculate plants with SMV in five of the plots of this experiment.
3. To instruct Dr. Victorio García in procedure to use for inoculation with SMV on 24 March.
4. To install a passive trap for collection of aphids in the SMV field experiment.

ACCOMPLISHMENTS:

1. The four purposes stated above were fulfilled.
2. I visited Dr. Goro Kuno, Insect Pathologist at Mayaguez and Instructor of a course in general virology (Biology 533), and delivered an isolate of cowpea mosaic from Puerto Rico for use in his classes.
3. I delivered to Luis Ortiz, Administrator Subestacion de Isabela, a work plan describing the SMV field experiment as requested by Dr. Lidy Lopez, Estacion Experimental Agricola, Rio Piedras.

DETAILED ITINERARY:

- 11 March Flew CMI/ORD/SJU/MAZ. Checked into Hilton Hotel at Mayaguez. With Dr. Victorio García visited Dr. Paul Powell, Tropical Mycologist at UPR, Mayaguez; and Dr. David Walker, Entomologist at the Federal Nuclear Center.
- 12 March Drove to Subestacion de Isabela and worked entire day roguing field plots and marking plants to be inoculated. Visited Dr. E. Hamer Paschal at home in the evening.
- 13 March Met Dr. García at Mayaguez. Inoculated soybean plants with soybean mosaic virus at his greenhouse at LaFinca for his use on 24 March. Drove to Isabela with Dr. García. Inoculated field experiment. Surveyed recently planted soybeans for diseases. We found evidence of several seedling diseases, including dead and dying plants with vascular discoloration and Sclerotium-like symptoms and others with symptoms similar to those of Rhizoctonia infection. We collected samples for isolation and study by Dr. García. We constructed and installed a device to support lucite plates for collection of aphids in the field. We then returned to Mayaguez. Met Dr. Goro Kuno at his laboratory, and prepared a buffer in the laboratory of Dr. P. L. Meléndez for Dr. García to use in his inoculations on 24 March. In evening visited with Dr. García.

14 March Drove to Isabela to make virus collections and examine plots inoculated on 13 March. Sr. Frank Julia, with whom I had an appointment, was ill and not in. Returned to Mayaguez, checked out of hotel. Flew MAZ/SJU/ORD/CMI.