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FINAL REPORT

of work done by

International Soybean Program, INTSOY,

University of Illinois at Urbana-Champaign

on

Contract AID/CM/TA-BOA-73-30
Task Order No. 1 - Guyana

September, 1975

Submitted by

International Soybean Program (INTSOY)
College of Agriculture
University of Illinois at Urbana-Champaign

Preface

Under provisions of the contract and Task Order No. 1, the University of Illinois, through International Soybean Program (INTSOY), was to assist the Government of Guyana to diversify its agriculture with particular reference to soybean research, production, marketing, and processing. The University of Illinois agreed to perform specific tasks in the area of agronomic research and production and in the area of economic research; marketing, processing, and utilization.

The contract was implemented through visits by technicians as follows:

A. H Boyd, seed technology: August 10-26, 1974; November 12-22, 1974.

Scott E. Cramer, soybean processing: January 13 - February 8, 1974.

Forster Davidson, soil microbiology: November 21 - December 14, 1973.

Lloyd R. Frederick, soil microbiology: November 12-22, 1974.

Kuell Hinson, agronomy and plant breeding: February 28 - March 10, 1974; September 7-14, 1974.

Carl N. Hittle, agronomy and plant breeding: September 25 - October 12, 1973; April 25 - May 13, 1974; June 23 - July 1, 1975.

A. I. Nelson, food processing: March 5-17, 1974.

S. W. Williams, agricultural economics: January 6-20, 1974.

A report of those activities and some resulting recommendations and conculsions follow: It is organized under the following headings:

1. General recommendations
2. Breeding and production
3. Inoculation with Rhizobium Japonicum
4. Seed processing and storage
5. Soybean processing and utilization

General Recommendations

1. More intensive training of Guyanese personnel in soybean research, production and extension is needed. With minor exceptions INTSOY could not provide such training under this contract, but strongly recommended it, and will advise about training programs when opportunity for such training becomes available. Under the contract INTSOY provided for visits to the World Soybean Research Conference at the University of Illinois on August 3-8, 1975 and to pertinent research, industrial, and other soybean-related enterprises of three staff members of the Ministry of Agriculture, Government of Guyana. Detail about those visits is provided in Appendix B.
2. In both research and production, more attention is needed to organizational detail and to getting jobs done on time. For better performance, the responsible personnel must be in close touch with operations at all times, and especially in critical periods, and should be provided with strong incentives for improved performance. If soybean research is to be carried out at Ebini, resident professional crop personnel need to be located there.
3. The extension component of the soybean development program is inadequate and needs strengthening. Effective demonstration plantings could play a key role in that program.
4. Additional equipment is needed at Kibilibiri, Ebini, and Mon Repos. It is suggested that Guyanese personnel develop lists of needed equipment and request INTSOY consultants to review them.
5. All personnel associated with soybean development in Guyana should review all available reports on soybean production. These include various reports by Dr. Hinson and his colleagues and Dr. Hazenberg submitted under previous contractual arrangements as well as the trip reports of all technicians who

worked on this contract. Periodic review of those reports should reduce the frequency of oversights in the implementation of recommended practices, as have occurred in the past.

Breeding and Production

Finding or developing varieties and production practices suited to Guyana is of fundamental importance to soybean production there. Consequently, breeding and agronomic practices received considerable attention under the task order. Professor Kuell Hinson made two and Professor Carl Hittle three trips to Guyana, and these were supplemented with supporting observations by the other technicians.

Purposes of their trips were mainly:

1. To help evaluate soybean breeding stocks and to recommend procedures for harvesting, handling, and propagating seed stocks for further evaluation.
2. To appraise varietal trials and production fields and to discuss soybean research and production programs with personnel of the Ministry of Agriculture and other interested parties.
3. To help plan future breeding and agronomic research trials.
4. To provide plant breeders in Guyana with additional soybean germ plasm.
5. To help determine areas best suited to soybean production in Guyana and to encourage research and production in these areas.
6. To assist in planning demonstration plantings of soybeans for use in extension.

Assistance provided in these areas covered a wide range. In general terms the more important were:

1. Provided detailed counsel in the plant breeding and varietal testing program designed to identify improved genotypes with potential for Guyana. This included specific recommendations for the handling of soybean breeding stocks.

2. Appraised research plots and production fields, and discussed priorities with local personnel. Developed tentative explanations for deficiencies in performance, and suggestions for dealing with them.
3. Discussed and helped to plan in detail future plant breeding, agronomic, and field production trials of both the Ministry of Agriculture and Blairmont Estate.
4. Provided supplementary materials from the United States for varietal trials and added germ plasm.
5. Presented seminar on "Soybeans: Protein Hope of the Future."

Various production, organizational, and management problems were identified. They, and some recommendations for dealing with them include:

1. Much more soybean cultural research is needed than has been done to provide an adequate basis for a recommended package of practices in soybean production. Such research is a prerequisite to efficient soybean production.
2. Particularly at Kibilibiri, but also in other commercial plantings, stands often were poor, plants short, yields low, and grass between the rows a problem. In some cases uneven maturity of the soybeans also complicates harvesting, adding to the need for special care in drying the seed. Suggestions for improvements in seed processing and storage (see pertinent section); continuing search for varieties that are taller than Jupiter when grown in the intermediate savannahs in the November-April season; more timely cultivation while grass is small; and possibly rotating soybean land with use as pasture if several years' cropping results in excessive weed problems.
3. It is imperative that plant breeding personnel concentrate on selecting the most promising material, advancing the segregating generations, havesting and storing seed so as to maintain adequate viability, obtaining seed increases of the most promising lines, and maintaining pure, carefully identified germ plasm for use in the program. Detailed suggestions for implementing the program are

included in Attachment B, Recommendations for Handling Soybean Breeding Stocks, of Dr. Hinson's trip report dated March 13, 1974, and in Section VI, Seed Multiplication and Variety Release, of his report of October 1, 1974.

Inoculation with Rhizobium Japonicum

Successful inoculation of soybeans with Rhizobium japonicum, which enables the plant to fix nitrogen from the air, promotes good plant growth with minimal applications of expensive commercial nitrogen. Consequently it was a phase of soybean production which received emphasis under the contract.

Two soil microbiologists, Dr. Forster Davidson and Professor Lloyd R. Frederick, visited Guyana on November 21-December 14, 1973, and February 24-March 8, 1974, respectively. Their major purposes were:

1. To counsel with and advise Mr. Harri Persaud, soil microbiologist at Mon Repos concerning legume inoculation, preparation of inoculants, inoculation experiments, and training in soil microbiology.
2. To introduce additional rhizobia strains into Guyana.
3. To assess problems in soybean inoculation in Guyana and to suggest procedures for coping with them.
4. To consider the feasibility of production of legume inoculants in Guyana.

Besides meeting the first two objectives, the soil microbiologists made these suggestions with respect to objective 3:

1. That trials, at least, be made with higher application rates of the soybean inoculant, to reduce nodulation failure and to stimulate plant development. This might involve placing inoculant in the soil rather than on the seed, possibly using granulated or pelleted inoculants. Higher application rates should be accompanied by limited N fertilization.

2. The generally low pH and in some cases possible Al toxicity of Guyanese soils complicates obtaining good nodulation. If adequate liming is not feasible, application of a limited quantity of powdered $CaCO_3$ in the row at planting time might encourage rhizobial development.
3. Nitrogen fixation is dependent upon the photosynthetic capacility of the soybean plant; good plant growth is essential to maximize benefits of inoculation.

With respect to objective 4, these ideas were proposed for consideration:

1. Guyana has an indigenous supply of peat which might be suitable for rhizobium production, though suitability has not yet been determined.
2. A plan for a legume inoculant pilot plant was developed. However, determination of needs and likely extent of the market should be considered in an economic analysis of its potential. Facilities of this type might be feasible if they produced all inoculum for the Caribbean community. Meanwhile, if made available, equipment now at Mon Repos could be used to prepare experimental batches of inoculum, although supplementary equipment is needed.
3. Loss of viability of imported inoculants as well as their cost should be considered in assessing potential for inoculum production in Guyana.

Seed Processing and Storage

Prompt, careful drying, seed processing, and storage of soybeans is of great importance in Guyana, especially for soybeans to be used for seed, but also for commercial operations. Dr. A. H. Boyd made two trips to Guyana to consult on this phase of the project. His objectives were:

1. To review the soybean seed and seed processing situation.
2. To identify problems and constraints in seed processing, drying, storage, production, and program development, and to assist the Ministry of Agriculture and other interested parties in their solution.

3. To give a seminar on seed handling to interested Ministry and Station personnel.

Major accomplishments included:

1. Detailed evaluation of seed processing and storage facilities at Mon Repos, Ebini, and elsewhere, with specific recommendations for modifications.
2. On second visit, consulted specifically with the staff about the production, processing, and storage of existing supplies of soybeans for seed.
3. Advised instructor in planning and developing materials for proposed seed processing course.

In summary, recommendations covered:

1. Specific suggestions for modification and operation of facilities at Mon Repos and other locations, and for handling of seed necessarily kept in open storage.
2. That Mon Repos should provide seed processing and storage primarily for its research programs, accommodating commercial seed only to the extent of available cleaner capacity. Kibilibiri, Matthews Ridge, Bookers, and any other locations that produce substantial volumes of seed should develop their own seed processing facilities and programs as soon as production is sufficient to justify doing so. Farm-scale equipment could be used at the start, with larger, more elaborate facilities as need develops.
3. The Ministry of Agriculture should put initial emphasis in its seed program on increasing seed production and on training extension and field personnel. Short term and limited long term training of key personnel in the United States is advisable.
4. The seed section should immediately investigate sealed bag storage and optimum moisture content and packing material for preservation of soybean seed.

Soybean Processing and Utilization

Economic conversion of soybeans into food and/or feed products adapted to Guyana's needs is essential if the nation's soybean program is to accomplish its purpose. Mr. Scott E. Cramer and Professors A. I. Nelson and S. W. Williams visited Guyana to assess the possibilities along these lines and to provide suggestions for their realization. Their objectives included:

1. To visit and appraise existing oilseed extraction plants and facilities which might be used for processing foods from whole soybeans.
2. To provide technical and monetary information about a multipurpose solvent extraction plant for possible future construction.
3. To assess current and projected supplies of oilseeds in Guyana by type and by area of production, and facilities needed to process them into oil and meal.
4. To provide GOG personnel with information about facilities needed and techniques used to produce foods from whole soybeans.

The more important accomplishments/results of their visits were:

1. Discussed in detail the processing of whole soybeans into various food products with concerned personnel of the Ministry of Agriculture and presented an informational seminar on the subject to a wider group.
2. Appraised existing oilseed processing facilities, available quantities and possible future supplies of oilseeds, and their relationship to volumes needed to meet prospective demand for edible oil and for effective use of a small solvent extraction plant.
3. Obtained and provided to GOG specifications and cost estimates for a 100-ton solvent extraction plant and for a Wenger laboratory-model extrusion cooker.
4. Provided suggestions on a timetable to be followed in developmental work on processing of whole soybeans, and detailed information about extrusion cooking

and other processing techniques.

Several important conclusions/recommendations were developed, including:

1. The present volume of oilseeds for processing is inadequate for effective use of a 100-ton solvent extraction plant, which is the minimum size that should be considered. The limited volume of rice bran and difficulties of getting it in for processing before it becomes rancid make it highly questionable whether extraction of rice bran will be feasible. With a limited and stable volume of copra available, a very substantial production of soybeans will be needed to support a 100-ton plant even after allowing for some possible expansion in oil palm production. For some time expanding production can be processed in the two existing expeller mills, which now are operating at only about one-third of capacity. Expeller processing can provide valuable experience in soybean milling before the more highly sophisticated operations of solvent extraction are undertaken. Further research and experience in soybean and oil palm production is needed before deciding whether or not to invest the $2.5 to 3.0 million needed in a 100-ton solvent extraction plant and where it should be located. However, detailed plans and cost estimates might be prepared for use if the needed volume develops.
2. There is a rapidly expanding demand for edible oil and animal protein in Guyana and the other CARIFTA countries. This demand assures a ready market for the products of any soybeans and other oil-bearing materials Guyana is likely to produce in the foreseeable future.
3. A Wenger X-8 laboratory model extrusion cooker would have wide potential use in developing food products from cereals as well as soybeans. One should be purchased for the government's food processing laboratory in Reumveldt Industrial Park. This is to be supplemented with a puffing gun, for which arrangements were made to ship a surplus machine from the United States.

4. Soybeans can be used most effectively in improving human nutrition if they are processed into food products which will be consumed directly by the people. Personnel at the food processing laboratory might advisably concentrate their attention on perfecting their skills in the production of a few promising foods made from whole soybeans and in adapting those foods to suit the tastes and eating habits of the Guyanese people.

A P P E N D I X A

Trip Reports of Technicians

TRIP REPORT - GUYANA

Date Submitted: October 30, 1973

NAME: Carl N. Hittle

TITLE: Professor of Agronomy

DIV./UNIT: INTSOY (International Soybean Program)
University of Illinois, Urbana, Illinois, 61801

PERIOD OF TRAVEL (inclusive dates): September 25 to October 12, 1973

ITINERARY: See Attachment A (Travel to Guyana under Task Order No. 1 of Basic Ordering Agreement No. AID/CH/TA-BOA-73-30).
Attachment used to include details of itinerary with time schedules.

PURPOSE:

1. As the first INTSOY member to visit Guyana to become familiar with the soybean situation, the soybean research and the soybean potential in the country in order that INTSOY can effectively assist the Government of Guyana (GOG) to diversify its agriculture with particular reference to soybean research in production, marketing, processing and utilization.

2. To gain as much information as possible that will be useful to the other six (6) INTSOY technicians who will be visiting Guyana within the next 10 to 12 months.

3. To visit organizations and personnel concerned with all aspects of the soybean program as a prelude to future visits of INTSOY technicians.

4. To give special attention to assisting in selection of breeding material -- since the soybean plant breeding plots, planted in June 1973, had not yet been harvested.

5. To concentrate on the soybean seed improvement and seed quality control program.

6. To discuss future agronomic and plant breeding research trials with appropriate personnel.

ORGANIZATIONS AND PERSONS CONTACTED:

Officials of the Ministry of Agriculture, the Central Agricultural Station (Mon Repos), the Ebini Research Station, the Kibilibiri Station, the USAID Mission to Guyana, the Hydrometeorological Service and some private sector organizations.

(See Attachment B for detailed listing.)

RESULTS/ACCOMPLISHMENTS:

1. Assistance was given to the plant breeding/variety testing program in order to identify additional improved genotypes especially suited for use in Guyana.

2. Discussed, in some detail, with the Ministry of Agriculture and USAID: (a) timing of visits, (b) frequency of visits, (c) counterpart personnel, (c) background information, and (e) areas of emphasis for the technicians of the International Soybean Program (INTSOY) who will be visiting Guyana.

3. Gathered considerable information which will be of help to specific INTSOY technicians and to assessment of the overall soybean program.

4. Visited organizations and personnel concerned with all aspects of the soybean program as a prelude to the future visits of the INTSOY technicians.

5. Discussed, in some detail, future agronomic and plant breeding trials.

(See Attachment A for additional details.)

FOLLOW-UP ACTION REQUIRED:

1. Discussion will be held with the other six (6) INTSOY technicians who will be visiting Guyana. The Guyana itinerary of each technician will be determined well in advance of each visit and the Ministry of Agriculture (GOG) and USAID/Guyana will be appropriately notified.

2. Additional information on soybean breeding, production, processing, marketing, utilization and seed quality control will be sent to supplement existing information in the library at Mon Repos.

3. Additional breeding material (soybean germplasm) will be provided for evaluation in Guyana. The International Soybean Program (INTSOY) will also assist in the mutual exchange of germplasm between Guyana and countries of similar latitudes.

4. Agronomic trials will be planned in detail and discussed with research personnel of Guyana for modification and determination of priority and location. These trials will include studies on: (a) plant population, (b) row spacing, (c) planting dates, (d) methods of planting, (e) fertilizers, (f) seedbed preparation, (g) weed control, (h) crop sequence and (i) methods of harvesting.

5. Seed studies will be planned to determine (a) the effect of fungicides on improving seed viability and germination, (b) adequate storage conditions to maintain seed quality, (c) the effect of various harvesting methods on seed quality, and (d) optimum times of harvesting in relation to seed quality.

6. An extensive collection of *Rhizobium japonicum* strains will be introduced and tested in Guyana to determine the most effective strains which should be used for soybeans. Assistance will be given to helping Guyana to decide whether to produce its own soybean inoculum or to import the inoculum that will be needed.

7. The INTSOY Agricultural Economist will assist in planning comparative cost of production and return studies of soybeans and other crops. As "Production Package of Practices" are developed, appropriate economic analyses will be made of these "packages". Soybean marketing systems will be analyzed and discussed with appropriate personnel.

8. The processing specialist will assess existing processing plants, proposals and recommendations and assist in determining the kind and size of oil-seed processing plant(s) needed to best satisfy Guyana's needs.

9. The food technologist will demonstrate various ways by which soybeans can be used for human food and assess existing soybean utilization research.

10. A long range plan for a soybean improvement program in Guyana will be developed, maximizing research, material exchange, training and production management opportunities available through the international soybean network.

11. An evaluation will be made, with concerned Guyanese institutions and personnel, of man-power or training needs for an integrated research-production soybean program, involving related farmer, business and government institutions working as a team under the direction of the Ministry of Agriculture.

OTHER REMARKS:

1. A great deal of breeding material exhibiting considerable genetic variation has been made available to the Central Agricultural Station under the GOG/University of Florida contract. It is imperative, at this time, to concentrate on selecting the most promising material, to advance the segregating generations, to harvest and store the seed so as to maintain adequate viability, to obtain seed increases of the most promising lines and to adequately maintain germ plasm which might be of immediate or future value to Guyana.

2. The excellent cooperation and efforts of many organizations and persons in providing facilities, information and contacts to make my visit more productive are sincerely appreciated. I am especially grateful to the extensive assistance of Ben Carter and Ronald Ullrich.

3. I regret that my stay in Guyana was not longer. If it had not been for the fact that the airlines lost my baggage and passport in Puerto Rico, I would have been in Guyana from September 16 to October 12, 1973 rather than from September 26 to October 12, 1973.

RECOMMENDATIONS:

Since I was in Guyana for only 16 days it would be presumptuous for me to make many meaningful recommendations at this time. However, in my opinion, suggestions and immediate action are in order relative to certain aspects of the soybean production research if the program is to develop within a reasonable period of time.

1. Plant Breeding -- Additional assistance, an increased sense of urgency and additional equipment are needed for (a) detailed and timely observations (data collection), (b) progeny selections to be made, (c) optimum timing of harvesting

of seed, and (d) adequate drying and seed storage. Number of days to reach maturity, lodging ratings, and mature plant height should be recorded at the time 95% of the pods of each breeding line reach maturity. Final individual plant and/or row selections should also be made at the time each progeny row becomes mature. To accomplish this, requires daily or tri-weekly observations and seed harvest by the plant breeder, or his assistant, at the time the soybeans are maturing. This year, for example, it was necessary for the soybean research coordinator (who is also the corn research coordinator) and his assistant to harvest corn plots at Ebini for a period of three days, in early October, when many of the breeding plots at Mon Repos should have been observed and harvested. When there are rains during the harvesting period, it is especially important to harvest the seed as soon as it reaches maturity so that seed deterioration and loss of viability do not take place. Under these conditions artificial drying facilities are usually needed followed by adequate storage where both temperature and relative humidity are controlled. The seed storage unit at Mon Repos serves a very useful purpose for bulk short-term seed storage. However, it is questionable that it is adequate for the long-term storage of a large number of breeding lines required by the plant breeder. When new germ plasm (varieties, breeding lines, plant introductions, etc.) is introduced the breeder must make every effort to maintain viable seed of all promising material. A second or third introduction of a line should not be necessary.

2. Agronomic Studies -- To my knowledge, there were no agronomic (crop production) soybean studies conducted during the "long wet season" of 1973. One of the highest priorities for the Guyana soybean production program should be to develop a Package of Practices for Soybeans". A realistic and reliable "Package of Practices" for a given region and soil type cannot be developed and specific, or even general, recommendations cannot be made until considerable agronomic research has been conducted.

The steps for the "Package of Practices" include:

1. Use of a recommended soybean variety.
2. High quality seed (perhaps with fungicide seed treatment).
3. Proper seed inoculation with a highly effective *Rhizobium japonicum* strain.
4. Optimum seeding rate.
5. Optimum row width.
6. Optimum planting date.
7. Optimum, but economical, fertilizer rates.
8. Adequate weed control.
9. Timely application of insecticides to control insects.
10. Timely harvesting and proper threshing and storage.

DISTRIBUTION:

Ministry of National Development and Agriculture/Guyana -- 5 copies
(Attn: Mr. Ben Carter)

AID/Guyana -- 5 copies

AID/Washington -- 5 copies
(Attn: Mr. George Parman)

University of Illinois -- 15 copies
(Internal Distribution)

ATTACHMENTS:

A -- Detailed Itinerary and Schedule of Activities

B -- Organizations and Persons Contacted

ATTACHMENT A

DETAILED ITINERARY AND SCHEDULE OF ACTIVITIES

September 26, 1973

By plane from Port of Spain, Trinidad, to Georgetown, Guyana. 0035/0230

A.M. Contacted USAID officials and met briefly with L. L. Petersen and R. E. Ullrich.

P.M. Ronald E. Ullrich and I had preliminary discussions with Dr. Alfred V. Downer, Principal Agricultural Officer, Central Agricultural Station, and H. A. D. Chesney, Deputy Chief Agricultural Officer. The proposed visits of the INTSOY technicians were discussed. Dr. Downer emphasized the need for follow-up visits of at least some of the technicians.

September 27, 1973

A.M. Familiarized myself with results of soybean trials previously conducted at Ebini and Mon Repos and with breeding material, instructions and proposals that had been furnished by Dr. Kuell Hinson, University of Florida.

P.M. Ron Ullrich and I visited the soybean breeding nursery at Mon Repos with Christian Nwasike. None of the plots was yet harvested, although many progeny rows had reached maturity. There is tremendous genetic variability in this breeding nursery. Notes which have already been taken include plant height, height to lowest node, relative amount of pods per plant and lodging (all at 55 days after planting). In addition, the number of days to flowering has been recorded. Additional notes needed are maturity ratings, lodging at maturity, and height at maturity. Individual plant selections and bulk selections, where appropriate, should be made as soon as possible. Mature seed should be harvested and dried as soon as possible to prevent seed deterioration caused by the frequent late rains and high humidity.

September 28, 1973

A.M. To Mon Repos to determine soybean literature already available in the library so that INTSOY might assist with providing additional soybean information.

Went over the detailed records of the breeding material in the soybean nurseries (parentage, generation after crossing, objective for making the crosses, etc.) in order to be of assistance in establishing proper criteria for making selections.

P.M. Determined appropriate methods for rating all the soybean breeding material for relative maturity and standability (resistance to lodging). Observed, in detail, all progeny rows.

October 1, 1973

Discussed, with Ben Carter and Ron Ullrich, the general and specific considerations for the seven INTSOY technicians from the University of Illinois, including (1) the contact personnel (Guyana counterparts) for each technician, (2) the optimum time(s) for each technician to visit Guyana, (3) the information to be provided the INTSOY technician before his visit, (4) the areas to be considered for soybean production, (5) the location of soybean processing plant(s), and (6) the present status of research facilities, oil processing units, studies being made, and plans for the immediate future. Mr. Carter indicated that follow-up visits by many of the INTSOY technicians would greatly strengthen the program and considered such visits imperative.

After visiting with various personnel and observing the program I am in agreement that provision for multiple visits to Guyana, for at least some of the INTSOY technicians, is highly desirable.

October 2, 1973

A.M. Spent additional time familiarizing myself with information on file in USAID/Guyana offices.

P.M. To Mon Repos -- Brief visit with Dr. Downer and additional visit to the library.

October 3, 1973

A.M. Visited with Vincent Hinds relative to oil and food processing. To Mon Repos, visited with Harry Persaud, Microbiologist. It appears that one of the first steps in soybean microbiology is to screen existing *Rhizobium japonicum* strains in order to determine their effectiveness under conditions in Guyana. Considerable attention and study needs to be given to determining if Guyana should attempt to manufacture their own *Rhizobium japonicum* inoculum or import the needed inoculum.

Visited the seed storage unit at Mon Repos. Seed is maintained at approximately 73°F (23°C) and 40% relative humidity. Seed storage, seed quality control, seed processing and seed certification will be studied in much more detail.

P.M. Classified all material in the breeding nursery for maturity; at Mon Repos.

October 4, 1973

From Georgetown to Ebini Research Station and Kibilibiri, by plane, with Ben Carter, Louis Amsterdam, Nazim Kazim and pilot. Christian Nwasike returned with us from Ebini to Georgetown. The soybean variety trial at Ebini looks excellent. Many of the entries are well podded with considerable height (as high as 36 inches). There is some pod abortion. The trial has been well cared for. There are no weeds or disease and insect damage. Most check rows of Jupiter are blank rows because the Jupiter

seed used was of poor quality and did not germinate. Therefore it is not possible to make direct comparisons of the entries with Jupiter. This trial was planted on July 5, 1973. Most entries are in the green pod stage. Most pods are well developed Some of the breeding lines from Jamaica are very late and are still flowering, even though the same plants that are flowering also have well developed pods.

Kibilibiri has more than 250 acres of soybeans, all Jupiter. About one half of the crop has been harvested but harvesting has been very difficult due to the excessive rainfall, which apparently is very unusual for this time of the year. Some soybean production fields are weedy.

October 5, 1973

A.M. Visited in some detail with Vincent Minds relative to soybean processing and utilization.

After careful consideracion, and in view of the comments by Ben Carter, Dr. Alfred Downer and others, the rationale and justification for the multiple visits of specific INTSOY technicians was written out in some detail and submitted to the Assistant Program Officer USAID/Guyana.

P.M. Spent additional time familiarizing myself with pertinent information in the USAID/Guyana "Memory Bank".

October 6, 1973

A.M. Took detailed notes (classification) of the standability (resistance to lodging) of all the breeding lines (progeny rows) in the soybean breeding nursery at Mon Repos. Some breeding lines appear to have excellent resistance to lodging, other lines are very susceptible to lodging.

P.M. Attended the 6th National Agricultural Exhibition. This is the first year that the Agricultural Exhibition has been held at the new site, Plantation Sophia, Georgetown. This is now the permanent site for the exhibition. There were many fine exhibits. Obviously a lot of people had worked very hard to make the exhibition a success. In spite of frequent and excessive rain during September and October and the inherent difficulties associated with the construction of a new site, it was well organized and arranged and the exhibits were well manned.

October 8, 1973

A.M. At Mon Repos. Discussed, with Christian Nwasike, the details of the soybean breeding program and the notes I had taken, on October 3 and 6, when he was harvesting corn at Ebini and working at the Agricultural Exhibition. We went through the entire nursery and discussed the intensity of selection, the need for both individual plant selection and bulk row selection of the better material and the urgency of harvesting and drying selected plants and rows which have reached maturity.

P.M. Started writing the Trip Report (Guyana).

October 9, 1973

A.M. Additional discussions with the AID/Guyana Assistant Program Officer. Visited the Hydrometeorological Service of the Ministry of Works and Communications to obtain additional rainfall, temperature and other climatological data. Personnel were very helpful in providing additional information and suggestions.

P.M. Held discussions with the Senior Economist, Mohammed Naseer, Ministry of Agriculture relative to the forthcoming visit of the INTSOY Agricultural Economist. Mr. Naseer was very helpful in providing information on production costs and returns of various crops.

October 10, 1973

A.M. Visited Mr. Radha Persaud of Resaul Maraj and Co. relative to oil processing and needs in the country. He made arrangements for me to visit the Maharaj Oil Mill, Cove and John, East Coast, Demerara. This oil extraction plant operates two Anderson Expellers (manufactured in Cleveland, Ohio) each with a capacity of 15 tons per day. They start with copra at approximately 6% moisture and 60% oil. After the copra has been run through the expellers the copra meal contains about 6% oil and 19% protein. In anticipation of having appreciable quantities of soybeans, the Maharaj Oil Mill purchased, from Anderson, the appropriate rollers and other equipment for soybean processing. However, this equipment has not been used since supplies of whole soybeans have not yet materialized.

P.M. Visited Dr. Reginald Clarke, who is presently officed at the Analyst Dept., Ministry of Health. He took me to the new Food Processing Center, in the Industrial Park, where they are processing peanut butter and where a food processing pilot plant research operation is being set up. They already have an excellent drum dryer (small one for research purposes), steam boiler and other equipment. Dr. Clarke is well trained and has many excellent ideas relative to the incorporation of soybeans into food products on a medium to large scale basis, which would appreciably increase protein intake and alleviate malnutrition and/or malnourishment.

October 11, 1973

A.M. Visited with H. N. Ramdin relative to the soils of Guyana. He provided soil survey reports and other useful information.

Visited with H. A. D. Chesney relative to the need for additional agronomic trials which he feels should be conducted in the near future.

Discussed with Ben Carter the optimum time for each INTSOY technician to visit Guyana and the need for (a) more adequate seed storage at Mon Repos and Ebini, (b) more personnel to assist with soybean research, (c) training of additional personnel in seed improvement, plant breeding and agronomy, and (d) more equipment in the microbiology laboratory, the seed testing laboratory, and the food processing center.

Picked up additional climatological data from the Hydrometeorological Service.

P.M. Visited in more detail with Christian Nwasike relative to plant breeding and varietal trials.

Visited the seed processing unit with Mr. Soni Persaud. They have a dryer, scalper, cleaner and grader --- all which appear to be in good condition. They mainly process corn, soybeans, blackeyed peas and some rice. The seed processing plant and equipment needs to be studied in detail. A brief visit to the plant suggests that minor modifications of placement of equipment and procurement of additional equipment would greatly increase the efficiency of seed processing.

At the Mon Repos seed processing plant they have already cleaned some of the soybean seed recently harvested at Kibilibiri. Due to continued rains and difficulties in harvesting, much of the seed was damaged. Only 60% clean seed was recovered after processing --- with 40% "clean out" of cracked, shriveled, light weight or excessively small seed. However, the 8,000 pounds of clean processed seed had a germination of 90.5%.

October 12, 1973

By plane from Georgetown to Port of Spain, Trinidad. 0500/0615

ATTACHMENT B

ORGANIZATIONS AND PERSONS CONTACTED

Ministry of National Development and Agriculture

Ben W. Carter, Chief Agricultural Officer
H. A. D. Chesney, Deputy Chief Agricultural Officer
Vincent H. Hinds, Engineer, Special Projects
Mohammed Naseer, Senior Economist
H. N. Ramdin, Soil Scientist
Reginald Clarke, Ph.D., Food and Nutrition Development Unit

Central Agricultural Station, Mon Repos

Alfred V. Downer, Ph.D., Principal Agricultural Officer
R. E. Fletcher, Production Agronomist, (in charge of corn and soybean production at Kibilibiri)
Christian Mwasike, Research Coordinator and Soybean-Corn Breeder
Nazim Kazim, Production Agronomist, Cotton
Harry Persaud, Microbiologist
Soni Persaud, Assistant Seed Officer
Deo Paul Singh, Seed Processing and Storage

Ebini Research Station

Noel Holder, Livestock Officer and Director
Earl Munroe, Soybean Research
Clive Fraser, Corn Research

Kibilibiri - Global Agricultural Industries Ltd.

Louis Amsterdam, Site Officer
Keith Gordon, Assistant Site Manager

Hydrometeorological Service - Ministry of Works and Communications

K. E. D. Potter, Chief Hydrometeorological Officer
R. P. Ting-A-Kee, Hydrological Superintendent
John Bassier, Specialist, Hydrologist

Maharajah Oil Mills

(Resaul Maraj & Co., 18 Water Street, Georgetown)
Radha Persaud
(Oil Extraction Plant at Cove and John, East Coast, Demerara)
Doodie Persaud

Shell Chemicals

Asad Ishoof, Chemical Sales Representative, Shell Antilles and Guianas Ltd.
D. E. Chandool, Ph.D., Shell Trinidad Ltd. and Shell Antilles and Guianas Ltd.

USAID Mission, Guyana

Lawrence L. Petersen, Director
Robert M. Klein, Program Officer
Ronald E. Ullrich Assistant Program Officer
Edward J. Burns, Controller
Warren H. Frayne, Accountant
Quentin J. Wildman, General Engineering Officer
Gale A. Froemming, General Engineer
Lyndal R. Ashcraft, Executive Officer

TRIP REPORT - GUYANA

Date Submitted: Dec. 18, 1973

Name: Forster Davidson

Title: Soil Microbiologist (Soybean Inoculum)

Div./Unit: INTSOY (International Soybean Program)
University of Illinois, Urbana, Illinois 61801

Period of Travel: (Inclusive Dates) November 21 to December 14, 1973

Itinerary: By plane from Port of Spain, Trinidad, to Georgetown, Guyana. 0030/0230, November 21, 1973. Depart Georgetown, Guyana, 1315, December 14, 1973

Purpose:

1. Give assistance to the Microbiologist at Mon Repos.

2. To introduce additional strains of rhizobia into Guyana.

3. Assist in conducting rhizobial strain trials.

4. Discuss the feasibility of a legume inoculant pilot plant for Guyana.

5. To concentrate on research and development work in soil microbiology related to soybean production.

Organizations and Persons Contacted:

Officials of the Ministry of National Development and Agriculture, the Central Agricultural Station (Mon Repos), the Ebini Research Station, the Kibilibiri Station, and the USAID Mission to Guyana.

Results/Accomplishments:

1. Assisted in planning field trials for *Rhizobium Japonicum*.

2. Located and identified extensive peat deposits in Guyana.

3. Discussed in great detail research and development work in soil microbiology, e.g. methodology for testing and evaluating legume inoculants, isolation and screening of strains of rhizobia, techniques for evaluating peat as a carrier for rhizobia, basic procedure for doing serological testing, procedure for doing nitrogen fixation studies, etc.

4. A great deal of time was spent developing a plan for a legume inoculant pilot plant. (Attachment A)

Follow-up Action Required:

1. Additional strains of rhizobia for forage and grain legumes will be sent to the microbiologist at Mon Repos.

2. Additional information and literature will be forwarded on equipment and supplies needed in the soil microbiology program.

3. It would be desirable to make further observations on soybean field plots as well as the commercial soybeans planted at Kibilibiri at about flowering time or the pod filling stage.

Other Remarks:

1. It is important that the best strains of Rhizobium Japonicum be introduced into Guyana for commercial soybean production. This will involve fairly extensive "Mission Oriented" research and development work.

2. I sincerely appreciate the excellent cooperation and efforts of many organizations and persons in helping to make my visit as enjoyable and productive as possible. I am especially grateful to Harry Persaud.

3. I was greatly impressed by the dedication and sense of urgency of the research people at Mon Repos, Ebini and the Ministry of National Development and Agriculture. The heavy emphasis put on agricultural development by the Government of Guyana for 1974 is indicated by the fact that almost one third of the money appropriated for development projects is going to agriculture. This puts a lot of pressure on the limited number of research people in agriculture.

4. I was very favorably impressed with the work at Ebini and Kibilibiri. One gets the feeling from visiting these areas that they are dynamic areas of development. The experiment at Ebini on pasture improvement with combination of grasses and different forage legumes along with fertilization experiments obviously have great potential for commercial development of the intermediate savannas. The recognition of the fertility limitations of these soil types can have a marked influence on the development of crop production at Ebini and Kibilibiri. The fertility experiment on stylo at Ebini illustrates the potential of this forage legume under proper management. It will be interesting to see the final yield and nodulation data on this experiment. Citrus fruits and oil palm appear to be doing very well at Ebini and under proper management one would expect these to have commercial potential in this area. Data collected to date indicates that soybeans and peanuts both have great commercial potential. Since I have not had any experience in the dry season here, I can only speculate as to the possible effects of the dry season on crop production.

   When we visited Kibilibiri several hundred acres of commercial soybeans were observed. The plants were about three weeks old. Growth was vigorous and no visual symptoms of nutrient deficiencies or insect damage was evident. There was some problems with germination. No nodulation was found on the roots of the plants observed. Since 40 lbs. of N per acre had been applied at planting time, along with the fact that the soil PH was about 4.5 one would not expect nodulation to occur. Mr. Fletcher indicated he would expect a yield of about 1500 lbs. of soybeans per acre. Undoubtedly this area has great potential for commercial soybean production under the proper set of management practices.

   The white sands as observed at Long Creek appear to have considerably less potential for crop production than the brown sands at Ebini and Kibilibiri. Care should be taken not to drastically upset the ecological balance that exists in the white sands. When

the native vegetation is removed and crop production is allowed to deplete the soil organic matter what little fertility now exists may be lost. It may be difficult for these soils to revert to natural vegetation and water holding capacity.

Recommendations:

1. An urgent need exists to broaden the base of agricultural research to lend support to the commercial operations at Ebini and Kibilibiri as well as to offer some help for th small farmer.

2. The microbiologist at Mon Repos needs at least one or two well trained technicians. Laboratory, transfer room, and equipment are totally inadequate to do work on rhizobia or soil microbiology in general.

3. At Kibilibiri I would recommend that the rates of soybean inoculant application be increased - the amount of increase should be correlated with the results of the current field work in this area. N application should be reduced to about 15 lbs. per acre; however, if nodulation fails then yields of soybeans will be no more than the yields supported by 15 lbs. of N. If the soil cannot be limed adequately, one should at least apply some powdered $CaCo_3$ at the time of planting in order to create a micro-environment in the vicinity of the germinating seed which will favor rhizobial development and nodulation.

4. I would highly recommend the establishment of a pilot plant/commercial unit for the production of legume inoculants if the acreage objectives for soybeans and forage legumes are sufficient to warrant the capital investment. However, the suitability of indigenous peat for inoculant production is yet to be established. The loss is viability of imported inoculants as well as the cost are sufficient justification for indigenous production.

Distribution:

Ministry of National Development and Agriculture/Guyana: 5 copies (Attn. Mr. Ben Carter)

AID/Guyana: 5 copies

AID/Washington: 5 copies (Attn. Mr. George Parman)

University of Illinois: 15 copies (Internal Distribution)

Attachments:

Attachment A - Pilot Plant for the Production of Legume Inoculants

ATTACHMENT A

PILOT PLANT FOR THE PRODUCTION OF LEGUME INOCULANTS

Introduction

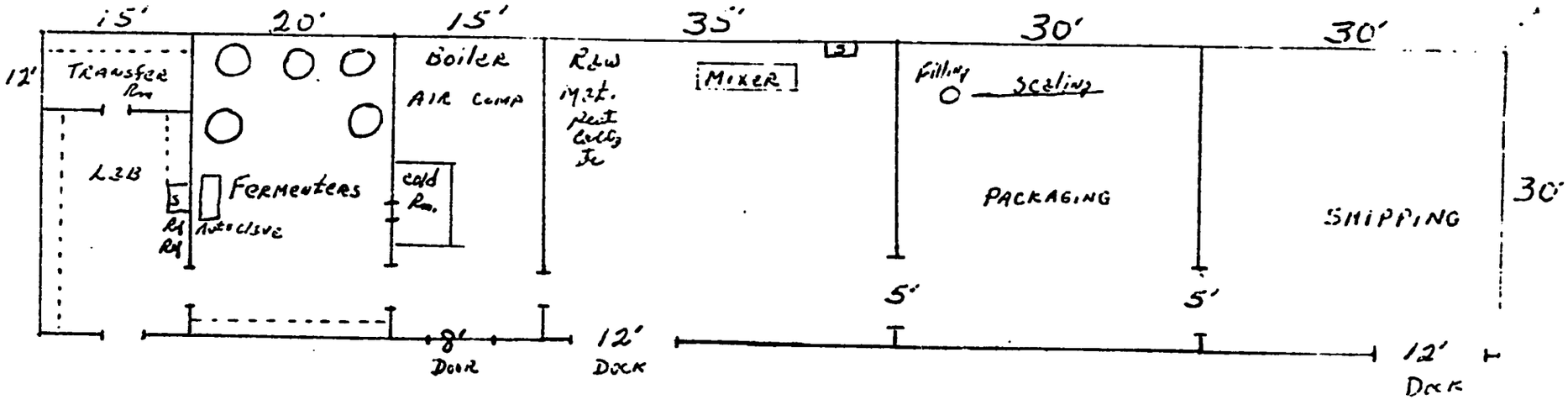
The author has tried to outline some of the basic requirements for a pilot plant/commercial operation for the production of legume inoculants. While there is nothing magic about the physical plant design, it is important to observe "flow-through" design as well as proper location of equipment. Since contamination can be a problem in the laboratory and fermenter room, these facilities should be designed with a high standard of sanitation in mind.

The Need for Inoculation

When a forage or grain legume is grown on a soil for the first time it is essential to inoculate or introduce the appropriate rhizobia at the time of planting. This is usually done by moistening the seed with water just before planting and applying a viable culture of rhizobia to the seed. Care should be taken to insure that the correct rhizobia are used on the plant species involved; eg. soybeans require *Rhizobium japonicum*. *Rhizobium japonicum* is not effective on other legume plants.

The appropriate rhizobium bacteria establishes a symbiotic relationship with the plant whereby the rhizobium is able to fix or enzymatically reduce atmospheric nitrogen which is used by the plant. The symbiotic relationship is established in the nodules on the roots of the plant. The plant provides the rhizobia with carbohydrates, minerals, and other essential growth substances.

There seems to be some diagreement among research workers as to the amount of nitrogen that is fixed by the rhizobia. Most soil microbiologists would agree that most if not all the nitrogen needs of the plant are met by the symbiosis when good nodulation occurs with an effective and an efficient N-fixing strain of rhizobia. Not all associations between rhizobia and legumes are beneficial. Some strains of rhizobia survive better, and fix more notrogen than other strains.


15'
20'
15'
35'
30'
30'
12'
TRANSFER Rm
L3B
Fermenters
Autoclave
Boiler
AIR COMP
cold Rm.
RAW
MIXER
Filling
Sealing
PACKAGING
SHIPPING
30'
5'
5'
8'
DOOR
12'
DOCK
12'
DOCK

Laboratory and Transfer Room

A good laboratory and transfer room are essential components in an inoculant pilot plant or production unit. There should be adequate facilities and equipment for doing basic research and development work on rhizobia. Some basic research and development will consist of maintenance of a rhizobial culture collection, isolation and screening of new strains of rhizobia, nitrogen fixation studies, and general mission oriented research. Rigid quality control standards should be followed.

A good bacteriological transfer room is one of the most important elements in the production of quality legume inoculants. The importance of keeping a rhizobial culture collection well identified and free of contamination cannot be over-emphasized. The transfer room should have ultra violet lights installed, gas outlets for laboratory burners, electrical outlets for a water bath and possibly a microscope. There should not be any windows in the room, unless they are completely sealed, and there should be only one door which should open into the laboratory. One laboratory bench about 30 inches high and running the length of the transfer room on one side should be sufficient.

Generally speaking the laboratory and transfer room are designed for bacteriological work. Extensive work with fungi where fungal spores may become dispersed should be discouraged. The presence of fungal spores in a transfer room can create very difficult contamination problems in rhizobial work.

Fermenter Room

The fermenter room where cultures are produced will require a high degree of sanitation. It is necessary to steam sterilize the culture media and inoculate the culture tanks asceptically. Sterile air is sparged into the tanks by means of a pre-sterilized glass wool filter. In the production of Rhizobium japonicum (soybean) it takes 3-7 days to achieve an acceptable rhizobial count in a fermenter. It is difficult to generalize in regard to rates of growth, because of the influence of culture media, temperature, aeration, strains of rhizobia, etc.

The location of electrical outlets, water lines, air lines, etc. can be determined after the fermenters are installed. Installation of a large (30") exhaust fan about 18-24" from the ceiling in the vicinity of the fermenters should be done when the building is constructed. Ultra violet lights may have to be installed if unexpected problems of contamination arise. Floor drains should be well spaced and adequate.

There is no such thing as an "ideal" fermenter design. Each one has its own advantages and disadvantages. In general a continuous fermentation system for rhizobia is undesirable, because of the long generation times of rhizobia and the difficulty of operating a continuous system asceptically. For rhizobia production the batch system is much prefered. The fermenter should be made of stainless steel. Details of design of a fermenter are extremely important to the success of the operation. For a pilot plant the minimum size probably should be 150 gallons and the maximum 300 gallons.

A large horozontal autoclave(at least 30" deep x 22" diamter) should be installed in the fermenter room close to the door into the laboratory. It will be needed by the fermenter room operator as well as the laboratory. Laboratory base cabinets should be installed in one end of the fermenter room. A small balance and a larger balance(0-10 kg.) will also be needed.

Boiler Room

Space for a boiler or steam generator, an air compressor, and a cold room(8'x10') which opens into the fermenter room must be provided. It is preferable to locate the boiler and air compressor as close to the fermenter room as possible. The boiler or steam generator should be approximately 5BHP in order to sterilize fermenters, operate the autoclave, and steam sterilize transfer lines, etc.

Shipping Room

This room serves as an area for temporary storage of finished product and space for addressing and shipping. Benches may be needed, but can be added later as the need arises. The assumption is being made that temporary storage of the finished product can be done under ambient temperatures and humidity. If this assumption is later found to be incorrect, then it will be necessary to install a partition in the shipping room and install air conditioning.

Cartons, polyethylene bags, and sealing tape can be stored in this area, but care should be exercised in keeping them clean. A small manual tape dispensing machine along with a variety of carton sizes can facilitate shipment of orders of various quantities of inoculum. A set of scales (0-100 lbs) for determining weights will be needed.

Inoculum is a pershable product and one should emphasize the fact that care should be exercised in expediting shipment to the user. Expiration dates on the inoculum package should be strictly adhered to. Viability of the product must be assured at the time of use. Inoculum should not be sold or used after the expiration date or after unsatisfactory storage.

Manpower Requirements

Professional :

a. Soil microbiologist -

b. Technicians - 2

c. Laboratory assistants - 1

* Office - secretary - 1

Laborers:

a. Fermenter room operator

b. Mixer-blender operator

* c. Filling machine operator

* d. Shipping

* e. General laborers - 3

* These people can be recruited after volume production begins.

ANALYSIS OF COSTS AND RETURNS

	Approx. US $
Fixed Costs:	
Building and Land	
Greenhouse	
Machinery and Equipment:	
Air compressor, 15-25CFM, 5 HP	1000
Fermenter, 165 gallon, stainless steel, used	800
Air conditioners, 2	900
Laboratory oven	300
Refrigerators, 2	500
Laboratory shaker	800
Microscope, Nikon, interference phase	1500
Misc. Laboratory glassware and supplies	2500
Steam generator or boiler of 5 BHP	3000
Autoclave	2000
Cold room, compressor, etc.	4500
Rotary mixer-blender, commercial size, 10 cu. ft.	4000
Packaging Equipment (filling machine and sealing machine	7500
Aging pans , 30"x22" x 8", fiberglass	1500
Misc. piping, valves, air regulators, air holding tk, etc.	1200
Scales, 0-200 lbs, 3	800
Serological water bath	300
Tape dispensing machine	200
½ gallon glazed crocks	200

Expendable Materials:

Plastic bags, 2½ mil, 5" x 7" for 1 acre, 50,000 - - - - - - 1000

Plastic bags, 3 mil, 5 acre size, 25,000 - - - - - - - - -1250

Cartons: 1. size to hold 12 bags acre size, 4000 - - - - - -2000

2. size to hold 12 bags, 5 acre size, 2000 - - - 1200

Calcium carbonate, technical grade, powdered, 2000 lbs — 75

Peat, local - - - - - - - - - - - 10 tons - - - - - - - - - - -

Mineral oil, white- 55 gallon drum- - - - - - - - - - - - - - 55

Gummed tape, 25 rolls- 75

Brown wrapping paper, 5 rolls - - - - - - - - - - - - - - - - 60

Sucrose, cane sugar, 200 lbs- - - - - - - - - - - - - - - - - 100

Mannite (mannitol), 200 lbs - - - - - - - - - - - - - - - - - 250

Salts, NaCl, $MgSO_4$, KH_2PO_4, K_2HPO_4, etc. - - - - - - - - - - 200
5 kg each

Yeast, bakers, local market - - - - - - - - - - - - - - - - -

Other Costs:

Shipping

Advertising and sales

Transportation

Interest

Depreciation

Income:

25,000 bags (acres) at G$3.00 each - - - - - - - - - - - - - - G$75,000

or

50,000 bags (acres) at G$3.00 each - - - - - - - - - - - - - - G$150,000

Summary:

Sales -

Operating costs:

Depreciation on buildings - - - - - - - - - - - - - - - - -

Depreciation on machinery & equipment- - - - - - - - - -

Expendable materials - - - - - - - - - - - - - - - - - - -

Interest -

Labor -

Utilities -

Total Operating Costs

Net Return:

Income from sales -

Minus operating costs - - - - - - - - - - - - - - - - - - -

Greenhouse

A greenhouse is essential for research and development work on inoculants as well as quality control work on the finished product. Total bench length of about 60 feet should be sufficient for an inoculant pilot plant. A 7 ft. x 30 ft. structure with 30 inch benches on each side should be sufficient. Artificial lighting may be needed. The greenhouse should be located close to or even attached to the laboratory.

PEAT PROCESSING

There are three basic steps in processing peat for inoculant use. The first step involves the removal of peat from the bog, preferably during the dry season. The second step involves drying the peat to about 10% moisture after the excess water has drained out. The final step is grinding the peat to about 200 mesh. A commercial hammer mill should work for this step, but may require more than one pass through the mill.

Detailed list of laboratory equipment and supplies

1. Nikon phase contrast microscope
2. Test tubes---500
3. Petri plates--500 glass or plastic disposable
4. Pipettes: 10 ml----100
   1 ml----100
5. Beakers: 100 ml----100
   150 ml----50
   250 ml----50
   400 ml----7
   600 ml----7
6. Stainless steel pipette cases---6
7. Erlenmeyer flasks: 1000 ml-------60
   500 ml-------20
   2000 ml------6
   3000 ml------6
8. Laboratory shaker capable of handling 18 flasks of 1 liter size.
9. Graduated cylinders:
   2000 ml-----2
   1000 ml-----3
   100 ml -----3
   50 ml -----3
   25 ml -----3
   10 ml -----6
10. Inoculating needles---6
11. Tuberculin type, 1 ml syringe--6
12. Slides and cover glasses----6 boxes each
13. Haemocytometer
14. Petroff-Houser bacterial counting chamber
15. Refrigerators --2
16. Bunsen burners,--- 2 large and 2 small
17. Florence flasks:
    3000 ml----6
    6000 ml----6
18. Laboratory oven
19. Laboratory balance
20. Hand tally
21 Quebec colony counter
22. Dilution Bottles
    8 oz.-----240
    16 oz.-----120
23. Metal trays to handle bottles
24. Test tube baskets
25. Test tube racks
26. Bacteriological Culture Media and Chemicals

Mannitol	
Sucrose	$CaSO_4$
Agar	Peptone
KH_2PO_4	Beef Extract
K_2HPO_4	Brom Thymol Blue indicator
NaCl	$KMnO_4$
$MgSO_4$	Hyamine
	etc.

Trip Report - GUYANA

Date Submitted: January 24, 1974

NAME: Sheldon W. Williams

TITLE: Professor of Agricultural Economics

DIV/UNIT: INTSOY (International Soybean Program)

PERIOD OF TRAVEL: January 6-20, 1974.

ITINERARY: Urbana, Illinois to Georgetown, Guyana and return.

PURPOSE: As a member of an INTSOY team to assist in GOG's program of diversification of agriculture with special reference to soybean research, production, marketing and processing, this initial assignment had the following purposes:

1. Begin economic analysis of potential areas of soybean production.

2. Analyze oilseed processing plant potentials and requirements to satisfy Guyana's needs.

ORGANIZATIONS AND PERSONS CONTACTED:

Officials of the Ministry of Agriculture, the Central Agricultural Station (Mau Repos), the Ebini Research Station, the USAID Mission to Guyana and some private sector organizations. (See Attachment A for details)

RESULTS/ACCOMPLISHMENTS:

1. In conjunction w/INTSOY colleague Scott Cramer began developing schedules of projected supplies of oil bearing materials and demand for fats and oils.

2. Prepared interim statement "Preliminary Impressions About Possibilities of Soybean Production and Processing in Guyana." (See Attachment B)

3. Prepared interim statement "Preliminary Judgments About Volume of Oil Bearing Materials for Processing in Guyana." (See Attachment C)

FOLLOW-UP ACTION REQUESTED:

1. During second visit work will concentrate on cost of production studies of soybeans and the problems in making such studies.

2. Prepare, in collaboration with Food Processing and Food Technology specialists, recommendations for the economic processing of soybeans to satisfy Guyana's needs.

DISTRIBUTION:

AID/W - 5 copies (Attn. G. K. Parman)
USAID/Georgetown - 5 copies (Attn G. S. Eason)
Ministry of Agriculture/GOG - 5 copies (Attn: B. W. Carter)
University of Illinois - 5 copies (Internal distribution)
INTSOY Staff
INTSOY Executive Committee

ATTACHMENT A

Organizations and Persons Contacted

January 8: Met with George S. Eason, Rural Development Officer, USAID, Guyana to discuss plans. Called on Lawrence L. Petersen, USAID Director. Visited Ministry of Agriculture and conferred with Ben W. Carter, Chief Agricultural Officer and P. D. Sookraj, Economist. (I briefly met Mohammed Naseer, Senior Economist, who is currently working with Nathan Associates on a food study). Mr. Carter pointed out their interest in obtaining solvent extraction facilities, indicating that rice bran, copra and potentially oil palm and cottonseed as well as soybeans would be available for processing. He strongly supported my proposal to make tentative estimates of volumes of material to be processed in order to provide data for Scott Cramer when he arrives. Consequently, I spent the rest of the day at the Ministry, with assistance from Mr. Sookraj and Balwant Singh, Statistical Officer, obtaining information about copra and rice bran including potential supplies of rice bran if all were milled.

January 9: After conferring briefly with Mr. Eason I returned to the Ministry to obtain data on potential production of oilseeds, especially soybeans and oil palm. Mr. Sookraj told me the best informed technicians were at Mon Repos, Christian Nwasike for soybeans and Miss Best for oil palm. He was unable to contact them during the morning, and I digested the limited information available about oil palm production and prospective supplies and demand for Guyana copra.

In the afternoon unable to contact Mr. Sookraj of Ministry by phone, so reviewed available information at USAID.

January 10: Morning worked at USAID office, starting preliminary estimate of quantities of oil-bearing materials available for processing.

In afternoon went to Mon Repos in a Ministry car, accompanied by Mr. Iserdut Seeraj of the Ministry. At Mon Repos I interviewed Miss Patricia Best, Oil Palm Specialist, about present and potential acreage and yield of oil palms in Guyana. I met briefly with Mr. Christian Nwasike, Soybean Breeder and R. E. Fletcher, Production Agronomist.

January 11: To Mon Repos in USAID vehicle with George Eason and Dr. George Summers of R.R. Nathan Associates. As Mr. Nwasike had gone to Georgetown and Mr. Fletcher had a class, I visited the agricultural school, particularly the food processing (canning) lab with my companions. We had a short visit with Dr. Davidson, the principal.

Later I visited the soybean (and maize) variety trials with Mr. Nwasike. In general, soybean stands were poor, many of the plants (40 days after seeding) still yellow, and plots were weedy. Problems had been intensified by excess rain - a reported 28 inches in December. After lunch I discussed the agronomy trials at Ebini and field production at Kibilibiri with Mr. Fletcher, obtaining production and yield data on the latter. After returning to Georgetown in a Mon Repos vehicle, I worked further on my estimate of available oil-bearing materials.

January 12: Completed preliminary estimate of quantity of oil-bearing materials available for processing. Critically examined in detail the cost of production studies of crops at Kibilibiri.

January 14: With Scott Cramer, visited Ben Carter both morning and afternoon. We discussed with him, in detail, his thinking as to the need for and potential of solvent extraction operations, and of the possible role of soybeans in those operations. We also discussed his interest in cost of production studies for soybeans and the problems in making such studies. It was agreed that I would work on such studies during the second half of my assignment, with the goal of updating the budgetary data in Hooker's linear programming study. It also was understood that the Ministry would provide a counterpart to work with me. After our visit to the Ministry, I reviewed with Scott Cramer the preliminary estimates I had prepared of available oil-bearing material and other pertinent literature.

January 15: With Scott Cramer, I reviewed available information bearing on projected supplies of oil bearing materials and demand for fats and oils and various livestock products. Subsequently we began developing schedules of projected supplies and demand. During the afternoon, with Dr. G. P. Summers of Nathan Associates, we visited Mr. Thakur Persaud and Son, operators of the Maharaja Oil Mills and discussed their operations.

January 16: In collaboration with Scott Cramer, I reviewed in detail information about the intermediate savannahs, particularly Carl Hazenberg's report. In the afternoon we visited two rice mills and saw the new rice storage in the rice growing area along the coast between the Demerara and Essequibo rivers. We emphasized rice milling operations and the amount and use of rice bran.

January 17: Visited Ebini Research Station with Scott Cramer, Christian Nwaiske, and Floyd Davis and William Burke of Nathan Associates. Examined soybean and other plots, reviewing research on soybeans in detail, with Messrs. Nwasike, Earl Monroe, Clive Fraser, Nazin Kazim, Harry Persaud, and others. In the afternoon we toured the extensive livestock pasture research area before returning to Georgetown about 5:30 p.m.

January 18: Prepared an interim statement of my impressions about soybean production and processing in Guyana and met with Mr. Ben Carter, Chief Agricultural Officer, Ministry of National Development and Agriculture.

ATTACHMENT B

Preliminary Impressions About Possibilities of Soybean Production and Processing in Guyana

S. W. Williams, University of Illinois

The comments that follow are based upon observations made and information obtained during my first visit, extending from January 7-18, 1974, inclusive. Obviously the period is too short for a person unfamiliar with the country to make anything more than highly tentative judgments.

The interest in soybeans at present is largely centered on their potential as a crop for the intermediate savannahs. As that is the only area I visited in which I believe they might possibly have a comparative advantage, my comments refer to soybean production in the intermediate savannahs.

Additional rigorous research is needed to evaluate the potential for soybeans in the intermediate savannahs. The fact that in 1970 average yields at Ebini on Tabela sand of six varieties averaged 45 bushels per acre as compared with 35 bushels for those same varieties in Florida in 1966 (1) suggests that, with proper management, well adapted varieties might do quite well. Some other experiments also have shown yields on research plots of some varieties of 35 or more bushels per acre (2,3,4,6). If, as suggested by experience elsewhere, yields on commercial fields are half that good, soybeans could be a competitive and remunerative crop.

However, the amount of research data on yields that is yet available is too limited to support a sound judgment. Further extensive experimentation is badly needed. It should include agronomic studies (date of planting, plant population, fertility trials, inoculum trials, etc.) as well as variety trials. For results to be meaningful, plots must be carefully prepared, protected against weeds and insects, and carefully managed. Findings should be summarized carefully and made available promptly.

The services offered by the INTSOY program at Illinois can help in this basic research program. They include (1) making available a wide variety of germ plasm, (2) suggestions for research and procedures based on experience in other tropical areas, and (I expect soon if not yet available) (3) findings from similar experiments with soybeans in other areas in the tropics.

With the limited research base, it is not surprising that results of attempts at commercial production at Kibilibiri have not been fully satisfying. Problems such as those involved in bringing the land into production and raising crops in a new area on an inherently infertile soil will make the quality of management especially important in determining the degree of success in soybean production. For that reason it will be important to have arrangements for production that provide management with a very strong incentive to do the best possible job.

In summary, success with soybeans in the intermediate savannahs will depend largely upon two factors, on neither of which there is adequate basis for passing judgment at this time:

1. Adaptation of soybeans to the area. There is promise that soybeans will do well there, but the potential needs careful study in a thorough and extensive research program.
2. If soybeans prove adapted, the quality of management will become the dominant factor determing success in production.

Solvent Extraction

The potential for solvent extraction depends upon the volume of oil-bearing materials that might be available for extraction. The impressions I formed about that during my first week in Georgetown are spelled out in a statement entitled "Preliminary Judgments about Volume of Oil Bearing Materials for Processing in Guyana" which is attached. In reading that statement it is important to keep in mind that copra is the only material now being extracted.

Consequently, judgments about volumes of other materials that it may prove feasible to process are subject to a wide range of error. Mr. Scott Cramer may comment further on this point out of his past experience in processing.

Demand for Oil and Protein

Although there may be some uncertainty about potential production and volume available for solvent extraction of oil bearing materials, there is no question about the rapidly expanding demand for edible oil and protein in Guyana and the other CARIFTA countries. FAO projections show these approximate increases in total demand in 1980 over 1970 (5):

	Percentage increase		
	Guyana	Jamaica	Trinidad
All fats and oils	40	55-70	42
Vegetable oils	33-67	33-42	38
Animal products heavily based on high protein feed			
Poultry meat	200	45-90	72
Eggs	200-233	50-75	38
Pork	--	50	83
Animal products based partly on high protein feed			
Whole milk	65-75	45-80	54
Beef and veal	60-80	40-55	80

The rapidly growing demand for edible oil and high protein meal will provide added incentive to produce oil bearing products and to provide solvent extraction facilities as soon as they can be operated economically. In recent years soybeans have had a greatly expanded role as a source of both edible oil and concentrated protein of high quality. Hopefully, further research will establish their potential as an important crop in the intermediate savannahs. If it does, successful production will be possible if production can be so organized that the individuals who are in charge of production have the needed information about production practices and strong incentives to provide management of high quality.

References

1. Hinson, Kuell. "1970 Soybean Variety Trials at Ebini, Guyana." In UF/GOG Contract, Vol. III, Soils, Field Crops, Vegetable Crops and Food Processing. (Photostat). Page 749.

2. Chetram, R. S. "Soybean Variety Trial at Ebini". In Agricultural Research Guyana. Ministry of Agriculture and Natural Resources, Central Experiment Station, Mon Repos. Page 17. Volume 4, p. 17. 1970.

3. Hinson, K. et al. "Soybean Research, (Breeding and Variety Testing)". In Annual Report of the University of Flordia Institute of Food and Agr. Sciences, Contract between the Government of Guyana and the University of Florida. Pp. 29-31. March 31, 1972.

4. Hinson, Kuell. "Jupiter, A New Soybean Variety for Tropical Latitudes". Fla. Agr. Exp. Sta. Cir. S-217. Page 6. June 1972.

5. Food and Agriculture Organization of the United Nations. "Agricultural Commodity Projections, 1970-1980". PM/B8870/871/E/1/5800. Adapted from pp. 400, 402, 393, 395, 392, 397, 390. 1971.

ATTACHMENT C

Preliminary Judgments About Volume of Oil-Bearing Materials for Processing in Guyana

At my first meeting with Mr. Ben W. Carter, Chief Agricultural Officer, Guyana, at which we discussed my assignment and that of Scott Cramer, Processing Specialist, who is to come next week, he emphasized Guyana's interest in obtaining solvent extraction processing facilities. He pointed out that oil-bearing materials potentially available for extraction include copra, rice bran, and - in the future - soybeans, palm oil, and possibly cottonseed. We agreed that I should attempt to estimate quantities of material that may be available for the information of the Ministry and to provide basic information needed by Mr. Cramer. The judgments I was able to form during my first week follow.

COPRA

"The domestic edible oil industry is based on the coconut. There are two screw press mills operating and which together press an average of 5,937 tons of copra per annum. This figure represents one-third of the combined pressing capacity of the two mills. The residual oil in the pressed meal varies from 6-8 per cent." (1, p.1).

Reported quantities of copra available 1962-71 show little if any upward trend (1, table 1). Although another report (3, part two, chapter two) with differing statistics shows some increase in the volume of copra over the past decade (p. 21), it also points out (pp. 18, 19) that yields have not been increasing, that the average age of the palms on estates of 300 acres or more, which account probably for 90 percent of the copra production. is relatively high, and that husbandry practices have contributed to difficulty in obtaining labor for harvesting.

Considering these factors, I am using for this estimate an available quantity of copra of 6,000 tons (presumably long tons of 2240 pounds) per year.

RICE BRAN

Rice bran is the by-product obtained in milling rice. Reported production in 1971 at the two central rice mills owned by the Guyana Rice Corporation showed rice bran equivalent to 8.5 percent of the quantity of paddy milled (1, tables 3A, 3B). It contains about 15 percent oil. For edible oil, the bran must be extracted within a day after being milled, but rancid bran may be processed to produce oil for industrial uses.

The writer has no background knowledge about extraction of oil from rice bran. The limited information available suggests two reservations that should be considered.

Overall, there are problems in obtaining and assembling the bran before it becomes rancid with the existing organization of rice milling operations in most countries. Apparently associated with this is more difficulty and expense in extracting oil from rice bran than from many other oil bearing materials. Thus, an evaluation of the status of the rice bran oil industry in 11 major rice producing countries of Southeastern Asia showed that in 1968-69 only six were producing rice bran oil at all (4, p. 2). Only in Japan, where rice milling occurs mainly in urban

areas in highly developed mills, and which is short of edible oil, was near half of the potential oil being obtained from rice bran. Moreover, only in Japan and Thailand was appreciably more than half of the rice bran oil being used for edible purposes. Overall, in these 11 countries only 13 percent of the potential rice bran oil was being produced. In three of the six countries in which there was production, the volume was declining.

A second problem in processing rice bran oil in Guyana is the present small volume of perishable rice bran available for processing per day. In 1971, the rice mill at MARDS produced 2,211 tons of rice bran in 238 working days; that at Anna Regina 1,553 tons in 171 working days (1, tables 3A, 3B). The total for the two mills, 3,773 tons, is about 15 tons per mill working day at MARDS. Unless a solvent extraction plant could readily switch over from rice bran to other oil bearing materials each day, it apparently would not be feasible to process much of the bran until after it became rancid, and the oil suitable only for industrial use. Probably this would considerably reduce potential returns from the oil.

Estimates based upon yields of rice bran at the two plants of the Guyana Rice Corporation and the country's rice production suggest that in recent years approximately 15,000 tons of rice bran per year might have been available for processing if all had been milled in the right types of mills at locations from which the bran might readily be assembled for oil extraction. While there may conceivably be such a potential volume, at present it is unrealistic to plan on any bran beyond that available at the two G.R.C. mills. As against a reported volume at those mills of 3,773 tons in 1971, in this preliminary estimate 3,500 tons per year is considered available for processing.

OIL PALM

There is interest in oil palm in Guyana. It is reported that 196 acres already are planted, and that there may be 1,000 acres within 2 or 3 years (6). The latter area is used in making these estimates.

Two sources (5: 3, appendix IV, P. 3) suggest that under optimum conditions mature oil palm may yield 1.6 - 1.65 tons of oil per acre. Assuming material to be of 20 percent oil content, for this estimate I show production at 7.0, 5.5, and 4.0 tons of palm fruit per acre, respectively, but use the median quantity in estimating additional oil-bearing material needed to operate solvent extraction facilities at indicated levels of capacity.

COTTON

Approximately five acres of medium staple cotton were grown in 1973 at Ebini. It produced about 7,000 pounds of seed cotton containing about 4,000 pounds of seed. The seed is being saved and it is planned to raise about 50 acres at Kibilibiri (7).

This crop is too new to support worthwhile judgments as to its potential for expansion. If it develops, cottonseed will be one of the products for which it would be desirable to have solvent extraction facilities.

SOYBEANS

Yields on research plots have ranged up to and in some cases about 40 bushels per acre, though many have been lower (9, 10). As would be expected, yields on larger acreages have not been that high. Below are data on area and yield per acre of soybeans at Kibilibiri based on notes I took in talking with Mr. R. E. Fletcher, Production Agronomist, during my second visit to Mon Repos (8):

Soybean Production at Kibilibiri

	Long Wet Season		Short Wet Season	
	Acres	Pounds per acre	Acres	Pounds per acre
1973-74	170	700 1/	150	growing
1972-73	3	1566	15	680 2/
1971-72	101	1312		3/

1/ Excessive rains affected fertility and intensified weed problems. Unusually heavy rain in September; lost perhaps 30 percent of crop.

2/ Very poor seed and low plant population.

3/ Poor seed and low plant population; most of crop not harvested as yield very poor.

There are obvious limitations to any judgments based upon this short experience with a new crop. For purposes of estimating needed supplies of oil-bearing material, I show calculations based upon three levels of yields: 25 bushels per acre, which is approximately the level obtained in southern United States and which I consider optimistic; 20 bushels per acre (moderate); and 15 bushels per acre (pessimistic). In terms of long tons (2240 pounds) these yield levels are approximately .67 ton, .54 ton, and .40 ton, respectively.

Supplies and Needs by Type of Material

Assumed supplies of oil-bearing materials (as discussed in previous sections) and acreages of soybeans needed at various levels of yields to provide capacity supplies for 50- and 100-ton plants operating 250 and 300 days per year are summarized below:

	50-ton plant		100-ton plant	
	250 days	300 days	250 days	300 days
Volume (T)	12,500	15,000	25,000	30,000
	Potential Supplies (long tons)			
Copra	6,000	6,000	6,000	6,000
Rice Bran	3,500	3,500	3,000	3,500

		Oil Palm, 1000 acres		
High (7T)	7,000	7,000	7,000	7,000
Medium (5.5T)	5,500	5,500	5,500	5,500
Low (4T)	4,000	4,000	4,000	4,000
Sub-total (using medium yield for oil palm)				
	15,000	15,000	15,000	15,000
Acres soybeans needed to provide capacity supplies				
25 bu./A. = .67T	-	-	15,000	22,500
20 bu./A. = .54T	-	-	18,500	28,000
15 bu.A. = .40T	-	-	25,000	37,500

APPRAISAL

In considering the judgments that have been presented, several points should be kept in mind:

1. Copra now is extracted in two expeller mills, which operate at one-third capacity. Copra, with 60 percent oil, may be too high in oil for successful processing solely by solvent extraction. It it is prepressed, and the cake diverted to the solvent plant for residual extraction, the colume to be processed would be only 2,400 tons per year instead of the 6,000 tons shown. If it is not prepressed, the two expeller plants presumably would be forced to close.

2. Extraction of rice bran would be an uncertain venture. Experience in other countries suggests that one must be optimistic to assume that it would be successful.

3. As oil palms are not yet in production, the acreage and volume of production assumed in making the foregoing calculations are in the realm of conjecture.

4. This information suggests that a 50-ton plant probably would handle all domestically-produced oil bearing material likely to be available within the next five years. The potential for importing such material (e.g. copra, soybeans) for processing should be investigated. Perhaps it would be feasible to build a 50-ton plant that could be enlarged later if necessary. First, however, the relative costs of building a 50-ton plant and operating it at moderately high levels of capacity should be compared with those of a larger plant operated at a smaller percentage of capacity and also with the results that might be attained with skillful operation of expellers. The volume of material for processing is so small that the risks of investing in solvent extraction must be recognized.

1. Ministry of Agriculture, Guyana "Background Information for the Establishment of a Solvent Extraction Plant Based on Rice Bran". Mimeographed. 5pp. plus 4 tables. May 1972.

2. "Acreage Planted, Acreage Reaped, Production and Yield per Acre, 1963-1972". (Rice). Typed. 1 page. No date.

3. O'Loughlin, Carleen. "The Coconut Industry of the West Indies". Caribbean Development Bank, Tech. Rept. 9. No paged. Nov. 1972.

4. UNIDO Regional Industrial Adviser, Agro and Light Industries, ECAFE, Bangkok, Thailand. "Ths Status of Rice-Bran Oil Industry in the ECAFE Region". United Nations Industrial Development Organization. ID/WG.89/7. Mimeographed. 13 pp. 4 Feb. 1971.

5. Grut, R. L. "Feasibility Study on Oil Palm Cultivation Prospect in Guyana" - Supplementary Report. Kuala Lumpar, West Malaysia. Mimeographed. 12 Oct. 1970.

6. Information from Miss Patricia Best, Palm Specialist, Mon Repos. Jan. 10, 1974.

7. Information from Mr. Nazim Kazim, Production Agronomist, Cotton, Mon Repos, Jan. 11, 1974.

8. Information from Mr. R. E. Fletcher, Production Agronomist in charge of corn and soybean production at Kibilibiri.

9. Hinson, Kuell. "Jupiter: A New Soybean Variety for Tropical Latitudes". University of Florida. Agr. Exp. Sta. Cir. S-217, table 1. June 1972.

10. Chetram, R. S. "Soybean Varietal Trial at Ebini" and "Soybean Varietal Trial at Black Bush Polder". In Agricultural Research, Guyana, Ministry of Agriculture and Natural Resources, Central Agricultural Station, Mon Repos. Vol. 4, pp. 16-19. 1970.

TRIP REPORT - GUYANA

NAME: Scott E. Cramer

TITLE: University of Illinois/Consultant

DIV./UNIT: INTSOY (International Soybean Program)
University of Illinois

PERIOD OF TRAVEL (inclusive dates): January 13 to February 8, 1974

TASK ORDER NO. 1 - Area of soybean production and processing plant requirements

PURPOSE:

As a member of an INTSOY team to make an assessment of the two existing processing plants and the available raw materials, copra, soybeans, and other crops; and develop a technical and economic feasibility on multi-purpose processing plants as outlined in Mr. Ben Carter's letter of January 15, 1974, attached; Attachment A.

ORGANIZATIONS AND PERSONS CONTACTED:

Officials of the Ministry of Agriculture, the Central Agricultural Station (Mon Repos), the Ebini Research Station, the Kibilibiri Station, the USAID Mission to Guyana, and several private sector individuals and representatives of corporations with emphasis on two oil mills, feed mill, layer and broiler growing operations, flour mill, vegetable oil refinery, transportation and carrier firms, sugar, rice, coconut, and palm oil plantations.

RESULTS/ACCOMPLISHMENTS:

1. Developed an understanding of the need for the production of an increased supply of vegetable oils and protein to assist Guyana in becoming more self sufficient.

2. Guyana is now producing annually vegetable oil - 8.2 to 9.3 million pounds, and import a total of 7.3 to 6.1 or total consumption 15.5 to 15.4 million pounds.

3. The problem simply resolves to:
   - Copra production is not increasing.
   - Palm oil production is approximately five years away (minimum except for 200 acres).
   - Cottonseed and peanut production undetermined.
   - Can or cannot soybeans be profitably grown, with application of expertise from United States and by the private sector which was the motivating force in the USA, Canada and Brazil to take the research from the scientist and put it effectively to work on the farm - Applied Research.

4. Application of Applied Research - Worked with all concerned on an agreed test plot program for soybeans to be planted April - early May, 1974, on commercial basis. Involves 100/165 acres by private sector - up to 1,314 acres by the Ministry of National Development and Agriculture in 1974.

5. Efficient and effective farm management of prime importance and this is where further work is so vitally needed by the farm manager.

6. Proceed with specifications for a 100 ton solvent mill with time table for need 1977-1978. In the meantime, the two copra mills can crush those beans which may be raised and not needed for seed. When the soybean harvest and yields are determined this September-October, 1974, changes should be made in new plant time table.

GOALS AND PRODUCTION POLICIES OF MINISTRY OF NATIONAL DEVELOPMENT AND AGRICULTURE OF GUYANA:

A. Development Goals:

1. To increase the production and marketing of specific agricultural commodities to a leveal of domestic self-sufficiency.

2. To maximize the export of agricultural commodities - with emphasis upon the marketing of surplus within the Caribbean community.

3. To allocate development investments equitably among the geographic regions of Guyana.

4. To create 10,000 new agricultural employment opportunities.

5. To increase and distribute income in the agricultural sector equitably between the smaller and larger producers.

B. Major Production Programs of Ministry Relative to Oils and Proteins:

1. A significant increase in the production of cereals - rice and corn.

2. An increase in production of peanuts, black-eyed peas, and other peas and beans.

3. A rapid increase in the soybean acreage.

4. Breakthrough in corn production in Intermediate Savannahs.

5. The attainment of an all time record output of copra and copra oil.

6. The introduction of oil palm cultivation by Demerara Co. in the Demerara River and then planting 800 to 1000 acres at Wauna.

7. A very great increase in poultry production.

8. Encouraging the formation of breeder farms.

9. Increasing the production of milk, beef and pork.

10. Manufacture of nutritious food for children and adults - based on soybean and rice.

THE GOVERNMENT'S NEED FOR GROWING MORE OILS AND PROTEINS VERY SOUND AND A NECESSITY:

Since 1968 the Guyana economy continues to expand mainly as a result of growth of bauxite construction and government services - the overall rate of real growth of GDP about 3% per annum.

Farming is still the largest sector of employment (about 1/3) second largest in terms of value output. There still is less than 5% of total area of Guyana under cultivation.

Population expansion has slowed some - growth rate now about 2 1/2% per annum. Now estimated as follows:

	1967	565,000 people
	1970	700,000
	1972	727,000
Projected	1981	848,000

The production of vegetable oils has remained fairly constant, ranging 7,000,000 to 9,835,000 pounds - 1964-1972, while import of vegetable oils has nearly doubled to 6,336,000 pounds during the years 1964-1972.

Poultry, eggs, and corn have risen mainly through the efforts of a few large producers, the sharp increase in output of pork has resulted from the activities of a large number of very small producers.

Poultry meat is the outstanding example of consumers choice of wanting protein on their table. The following striking example parallels the early development of the broiler industry in the USA with the development of high protein soybean meal, effective antibiotics and efficient management of layer and broiler flocks.

Years	Million pounds poultry meat produced
1964	1,882
1970	7,500
1973	12,500

CONCLUSION:

Soybean production - It is therefore decisive, in my opinion, of all the oil bearing seeds available to Guyana, that soybeans offer one of the highest potential crops for the farmers to produce successfully. I am greatly impressed with some of the management capabilities in the private sector and their eagerness to make some supervised soybean growing tests. The "time gap" existing from planting to harvest is most favorable compared to oil palm and/or coconuts.

My observations and recommendations are:

1. Applied Research - At this date we should place high priority on a program for planned growing tests and proceed with the one best variety developed - Jupiter. Mon Repos has custody of the seed. It has been agreed with Ben Carter to have several well managed growing tests with planting in early May to be harvested during September-October (dry season).

   In view of the 90" rainfall they have a major need for help from University of Illinois on:

   A. Proper handling of planting seed and inoculant.

   B. The application of weed killer and fertilizer (slow release).

   C. Control of ants.

   D. Preparation of soil and depth to plant.

   E. Combining or hand cutting, threshing, clearing and drying (several growers have lost their crop by storing bulk or sacked - without drying to 10/12° moisture).

A. TEST PLOT AGREEMENTS:

Agreements between Mr. Ben Carter and each of the following business firms or individuals have been made for April/May 1974 plantings.

			Acres
1.	Blairmont Estates, Ltd. West Bank, Barbice Guyana, S.A.	Winston E. H. Tyrell Administrative Manager	30/50
2.	Diamond Estates Diamond, East Bank Demerara	John Smith, Director Oil Palm Project	10
3.	D. A. Yearwood 48 Robb Street Lacytown		10/15
4.	Essur Doobay Land of Plenty, Essequibo	(son Bobbie) Phone 234 (Georgetown phone 68869)	10/50
5.	Baldeo Ramgoolan Sand Hills		20
6.	40 farmers - picked by government extension by Ben Carter		20
		Total Test Acreage to be Planted:	100/165

B. ACREAGE AND TEST PLOT AGREEMENTS WITH MINISTRY:

Ministry of National Development and Agriculture has targeted for 1974 planting according to Ben Carter:

		Acres
Ebini Research Station (sandy loam)		10
Mon Repos - North Plot		2
South Plot (sandy)		2
Global, Kibilibiri	Up to	800
Matthews Ridge	Up to	500
Total Acreage	Up to	1,314

C. FARM MANAGEMENT is of major importance. Previously, as an example, I reported some growers lost their soybeans by storing too high in moisture. These unfortunate happenings remind me of the many mistakes some of the USA farmers in Arkansas, Alabama, and Georgia made 25-30 years ago when first raising soybeans.

Good farm management practices are critically important to success.

It is most fortunate that George Eason has been raising soybeans in northwestern Iowa for nearly 30 years. After our many visits with farmers, he strongly recommends, and I fully support, that the University of Illinois seriously consider selecting an experienced farmer from the southern states who has raised soybeans successfully for 15 years or more to spend adequate time with the management of Kibilibiri.

Successfully managed soybean plots planted April-May this year can assist Guyana greatly. They cannot afford a management failure. These cross section plots should provide the knowledge whether soybeans can successfully be grown here.

2. Agronomic Research Projects on Soybeans - I am giving this second priority among the projects and recommend University of Illinois move ahead as Dr. Hittle outlined in his report of October 30, 1973.

3. Facilities for Crushing Oil Bearing Seeds -

A. Short Term:

Additional quantities of copra. soybeans, can be handled most advantageously through the established surplus capacity existing at the two copra plants because:

Any sizeable increase in copra looks very doubtful.
Oil palm is two years away.
Cottonseed and peanut are still in test plots.
A large part of the soybeans harvested in 1974 will be saved for seed - so there may be 100 to 600 tons available for crush.

Our estimate of soybeans harvested in 1974 range as follows:

Private sector:

Acres	Bushels	Long tons
100 20 bu/acre	2,000	60
200 " "	4,000	120

Combined private and government operations:

500 20 bu/acre	10,000	300
1,000 " "	20,000	600

B. Longer Term:

Proposed Solvent Crushing Plant

I recommend proceeding with plans for a business proposal with cost estimates for a multi-purpose plant located on the East Bank of the Demerara River with the capability of:

1. Receiving raw materials on water.
2. Shipping meal (eventually) to other Caribbean countries.

This location differs from H. A. L. Morris' report July 1973 - A Review of Oil - Seed Processing Projects for Guyana.

The vegetable oil imported 1968-1972 was 5,300,000 pounds or 530,000 bushels of soybeans; Attachment B.

To overcome the deficit in edible oil supply/demand this would require a plant with 100 ton p/day capacity - if there is only one plant the first few years.

Example of Capacity

Days operated per year	330	300	330	330
Tons crushed per day	25	50	100	150
Annual tons crushed:	8,250	16,500	33,000	49,500
Estimated Raw Materials Crushed - 1977				
Copra	8,000	8,000	8,000	8,000
Cottonseed	--	--	--	--
Peanuts	--	--	--	--
Oil Palm	three years away			
Rice Bran - possibility	1,000	1,000	1,000	1,000
Tons soybeans needed	--	7,650	24,000	40,500
Bushels soybeans needed	--	252,000	792,000	1,336,000

I will proceed with development of a plan and have by April 1, 1974 detailed equipment, estimated cost, with time table.

I am most appreciative of the excellent assistance and guidance obtained from Mr. Ben Carter, Mr. George Eason, and other organizations.

ATTACHMENTS:

A - Letter from B. W. Carter

B - Table: Estimated consumption of fats and oils, 1964-1972

DISTRIBUTION:

Ministry of National Development and Agriculture/Guyana - 5 copies (Attn: Mr. Ben Carter)

AID/Guyana - 5 copies

AID/Washington - 5 copies (Attn: Mr. George Parman)

University of Illinois - 15 copies (Internal distribution)

MINISTRY OF NATIONAL DEVELOPMENT & AGRICULTURE,
P.O. Box 1001,
Georgetown.

IN REPLYING QUOTE DATE HEREOF AND N°

ATTACHMENT A

Guyana

15th January, 1974.

Cooperatively yours,

From:- .....
B.W. Carter
Chief Agricultural Officer

Dr. S.E. Cramer,
U.S.A.I.D.,
Main Street,
Georgetown.

Dear Dr. Cramer,

Study to determine the technical and economic feasibility of establishing a multipurpose solvent extraction plant in Guyana.

With regard to the above-mentioned project, I am supplying as requested, a list of the objectives of the study:-

Objectives:

1. To determine the amount of soyabean, rice bran and copra meal available for solvent extraction;

2. To determine the possibility of establishing a solvent extraction plant of 50 tons per 24 hours capacity (with the possibility of expansion) capable of extracting rice bran, copra meal and soyabean meal and the economics of its operation;

3. To determine the size and cost of a refining unit to cater for the output of the factory;

4. To estimate the size and cost of a batch hydrogenation unit and the economics of its operation;

5. To visit the two existing oil mills and advise the owners on the feasibility of expelling soyabean and of the refining of soyabean oil;

6. To appraise the proposal for the 25 ton plant;

7. To advise on the utilisation of crude rice bran oil for soap and other forms of useage;

8. To fill out the Rosedowns questionnaire on the solvent extraction plant and the other on oil

FATS AND OILS

Table: Estimated Consumption of Fats and Oils, 1964-1972

Item	In thousands of pounds unless otherwise indicated								
	1964	1965	1966	1967	1968	1969	1970	1971	1972
Butter and Ghee									
Produced	1,781	2,074	2,302	2,756	2,739	2,488	1,806	2,494	3,366
Imported	854	1,017	1,034	833	788	1,021	953	911	1,274
Exported	-	-	-	-	-	-	-	-	-
Consumed	2,635	3,091	3,336	3,589	3,527	3,509	2,759	3,413	4,640
Consumed per capita (pounds)	3.90	4.96	5.19	5.45	5.22	5.10	3.94	4.78	6.30
Vegetable Oils									
Produced	8,485	6,365	8,094	8,443	8,773	7,331	7,841	8,188	9,835
Imported	2,813	6,340	3,372	3,596	4,511	6,378	3,464	7,668	6,336
Exported	-	-	-	-	-	-	-	-	493
Used for soap	347	340	320	278	308	329	347	331	319
Consumed	10,951	12,365	11,046	11,711	12,976	13,380	10,958	15,525	15,357
Consumed per capita (pounds)	18.06	20.39	17.74	18.25	19.71	19.82	15.94	71.74	20.88
Animal Fats									
Produced	6	7	10	14	22	13	9	25	23
Imported	1,916	1,358	1,877	1,617	2,172	2,131	2,798	1,763	2,679
Exported	-	-	-	-	-	-	-	-	-
Used for soap	-	-	-	-	-	-	-	-	-
Consumed	1,972	1,365	1,887	1,631	2,194	2,144	2,807	1,788	2,702
Consumed per capita (pounds)	3.16	2.19	2.94	2.47	3.25	3.11	4.01	2.50	3.67

TRIP REPORT - GUYANA

Date Submitted: March 13, 1974

NAME: Kuell Hinson

TITLE: University of Illinois - Consultant

DIV./UNIT: INTSOY (International Soybean Program)
University of Illinois, Urbana, Illinois, 61801

PERIOD OF TRAVEL (inclusive dates): February 28 to March 10, 1974

PURPOSE:

1. To evaluate soybean breeding stocks and recommend procedures for selecting, harvesting, handling, and propogating stocks for further evaluations.

2. Discuss soybean research and production with MA and USAID personnel.

3. Assist in production problems.

ITINERARY:

February 28, 1974

Arrived Georgetown 20:30.

March 1, 1974

Contacted USAID office. Mr. Eason was in the Rupununi and did not return until next day. Placed telephone call to MA personnel at Central Agricultural Station (Mon Repos) to advise them of my arrival. Reviewed previous data on soybean research and reviewed INTSOY trip reports. Visited Mon Repos Station in the afternoon. Contacted R.E. Fletcher (Production Agronomist), Harry Persaud (Microbiologist) and Mr. Wharton (Assistant to Mr. Nwasike). Observed soybean research plots.

March 2, 1974

Met with Mr. Nwasike (Coordinator for corn-soybean research) and with Mr. Herman Adams (a newly appointed Research Officer who will assume some of Mr. Nwasike's duties). Attended staff seminar and met briefly with Dr. Downer (Principal Research Officer, Crops). Visited research plots with Mr. Nwasike, Mr. Adams, and their assistants. Met with George Eason briefly in late afternoon.

March 4, 1974

A.M. Visited with Mr. Nwasike and Mr. Adams. Further discussed possible cause of the poor growth and productivity observed in research plots. (See Attachment A). Discussed various aspects of production at Kibilibiri with Mr. Fletcher.

March 4, 1974

P.M. Met with Mr. Ben Carter (Chief Agricultural Officer), Mr. Eason, and Mr. Amsterdam (Production Manager at Kibilibiri). Discussed various aspects of soybean production and research, particularly the harvesting situation at Kibilibiri.

March 5, 1974

Spent entire day in soybean research plots at Mon Repos with Mr. Nwasike, Mr. Adams, and their assistants Mr. Wharton and Mr. Mangra. Made observations, recorded data, and discussed procedures.

March 6, 1974

Met with George Eason and Don Yearwood (a farmer from near Ituni) on two separate occasions. Discussed production schemes utilizing primarily hand labor. Left free time for consultation with estate representatives. Mr. Eason unable to set up meeting. Used free time to draft recommendations for harvesting breeding stocks when they mature and for growing next season. Copy of recommendation (See Attachment B) was left with Mr. Nwasike on March 8.

March 7, 1974

Flew to Kibilibiri with Mr. Eason, Mr. Fletcher, and Mr. Burke (Agronomist, Nathan Associates, Inc.). Met Keith Gordon (Assistant Production Manager). Observed corn and blackeye pea production, but gave special attention of soybean production, harvesting, and seed handling (See Attachment C). Stopped at Ebini on return flight, and observed soybean and corn research.

March 8, 1974

Spent entire day with Mr. Nwasike and Mr. Adams at Mon Repos. Discussed Attachment B in detail. Also discussed research techniques, record keeping, research objectives, etc. Made, brief final visit to research plots to review handling procedures. Visited briefly with Mr. Carter in the evening.

March 9, 1974

Left Guyana 10:20

ATTACHMENT A

Probable reasons for and consequences of poor growth

of research plots observed at Mon Repos.

Soybean plants in research plots at Mon Repos (Field 12), planted December 1-3, 1973, were 7-14 inches tall and were not well podded. In March 1973, their progenitors (in Field 38) were more than twice as tall and about 3 times as productive. We attempted to identify the cause(s) of poor growth and poor productivity.

Plants were yellow (as if N deficient) from soon after emergence until late January, then they turned green. Thus, inadequate nodule activity is strongly implicated, but its cause was not immediately apparent. Planting seed were inoculated. Some nodules eventually formed and plants turned green. If inoculation rates had been too low, less uniform results would have been expected. I would have expected some plants or rows to be normal.

The soil (Pagos coastal clay) may have been acid enough to cause aluminum toxicity. A November 1 soil sample had a pH of 5.0. One Ton/acre lime, added in mid-november, was expected to raise the pH of this soil about 0.3 pH units (C. Nwasike). Thus, aluminum toxicity cannot be ruled out. However, in an adjacent block, a few of the same genotypes were much taller and much more productive. The only known environmental differences were that the second block was planted later and the soil had received 150 lbs/A N (for corn) near November 1. Thus, inadequate nodule activity is again implicated.

The major cause of inadequate nodule activity appears to be associated with 29 inches of rain falling in December and continued heavy rain into January. (29 inches is a 40-year December record.) This amount of rain apparently saturated the soil to the extent of excluding gases. Edgar Hartwig has observed that prolonged saturation of Mississippi Delta clay soil (when soybeans are growing) causes nodules to slough off. Plants become nitrogen deficient and remain so until newly formed nodules become active. The two soils are similar. Thus, prolonged water saturation of the soil appears to be the major underlying cause of poor growth.

Although fertilizer N apparently would have been beneficial in this particular case, one should manage soybean fields in such a way that nodules can supply needed nitrogen. It is not practical to produce soybeans with fertilizer N.

If these interpretations are correct, they have both research and production implications.

1. Selection for productivity in this environment would be selection for tolerance to an abnormal situation. Few, if any, entries will yield at a profitable level. Thus little selection pressure should be exerted.

2. When soybean production is attempted on coastal clay soils, plantings should be on beds or ridges so that adequate drainage is possible during high rainfall periods. Research plots were on ridges in Field 12, but ridges apparently were inadequate.

Many rows in the nursery had poor stands. The water-logged soil undoubtedly caused some seeds to rot, but these seeds were damaged as a result of delayed harvests in October. Abnormal rainfall and competing responsibilities of harvesting personnel contributed to delayed harvests. Unharvested mature seeds lose viability rapidly in hot, humid environments. To avoid losing valuable breeding stocks, adequate precautions must be taken to insure timely harvests, proper handling and proper storage. The same principle also applies to large-scale seed production enterprises.

Recommendations for propagating breeding stocks are included in Attachment B. A related point will be discussed below.

Much effort was expended on soybean research at Mon Repos during the past season. The results will contribute little to variety development or improved production practices. The abnormally high rainfall in December could not have been foreseen. The suitability of Field 12 (in terms of pH, drainage etc.) for soybean production was questionable. A pertinent question is: Are sufficient precautions being taken to guard against low research productivity in future seasons?

The fields assigned for soybean research at Mon Repos next season have some questionable qualities and some unknown qualities pertaining to soybean production. For best results, fields at Mon Repos should be evaluated for their suitability for soybeans shortly before they are used for research plots. This can be done by growing soybeans (for seed increase, for marketing, or for plowing under) on selected fields to determine if they drain adequately, if soil ammendments are needed, or if some other problems exist. This would also establish Rhizobium japonicum populations in the soil. When a good soybean field is identified, it should be used several seasons for research plots.

In retrospect, it is obvious that more precautions should have been taken in field selection (or field management) for the 1973-74 season and in harvesting and handling seed last October for the December planting. One does not know in advance the nature and the extent of the precautions that will be needed. However, it is expedient, in the long run, to take precautions against abnormal situations that can be most detrimental and those that have the highest probability of occurrence.

The cost of adequate precautions may seem prohibitive. However, when balanced against several seasons of low research productivity, and the potential loss of valuable breeding stocks, it becomes obvious that all reasonable precautions must be taken.

ATTACHMENT B

Recommendations for Handling Soybean Breeding Stocks

Because soybean plots planted in December 1973 do not have typical growth and productivity, selection among the various entries probably will be ineffective. I recommend that all entries that produce sufficient seed be propagated again. Most entries are progenies from single plants selected from F4 rows grown in 1973. I recommend the following:

1. Harvest all seed from the best appearing row from each F4 or other late generation source to provide planting seed for yield tests in 1974, unless no one row will provide enough seed.

2. Harvest enough seed from each remaining row to plant an observation row in 1974 (like the one now growing) and to have enough remnant seed for replanting, should the need arise. (At least 200 seed harvested from each row, 90 of which will be planted, the remainder held in reserve.)

In some F4 (or other late generation) sources all rows will produce insufficient seed for including in replicated yield tests. In such situations, all rows should be propagated as in (2) above.

Preliminary identification of rows that will produce enough seed for 1974 yield tests totaled about 40, not including selections from F72-5508, 5509, 5510, 5511, 5512, 5513, 5514, 5515. For these latter sources as many as two or three rows may be selected. Final selection will depend on plant progress throughout the remainder of the season. Some rows now designated for yield-test may be deleted, and some others may be added.

The number of entries for 1974 yield tests probably will total about 60. These should also include samples from the multiplication rows located at the east end of field 12. With this large number of entries, it would be advisable to divide them into two tests. Border competition effects (in one-row plots) will be reduced if all indeterminant entries comprise one test and all determinant entries comprise the second test. Jupiter should be the check variety in both tests.

One-row plots replicated three times are recommended for the initial evaluation. If enough seeds are available, another three replicate tests should also be grown at Ebini. Rows should be 19-20 feet long. Harvest a 16-foot section or a 5-meter section from the central part of each row. Each plot will occupy about 60 square feet, including space for alleys and border areas. Thus, 180 plots will occupy about 1/4 acre at each location (Mon Repos and Ebini).

Plant 180 to 200 good seeds per row. Since lines are being evaluated for their potential as varieties for mechanized production, the planting pattern should simulate tractor planting. Seeds should be distributed uniformly along the row, rather than planting several seeds per hill in spaced hills.

For the Mon Repos test, select a site in which plants will make good growth. The situation responsible for the poor growth in plots now growing must be avoided if any critical evaluation is to be accomplished in 1974.

Rows not chosen for yield tests should be propagated in smaller plots. A 10-foot row is adequate, or it could be shorter. These rows will accomplish the purpose intended for the season now ending. Rows from the same source should be grouped together as in the December 1973 planting. It would also be well to include rows scheduled for 1974 yield tests in their respective positions in 1974 short, unreplicated rows (plots). Reasons for this will be discussed orally with Mr. Nwasike and Mr. Adams on Friday, March 8.

Slight modification in methods for keeping field records--to make records more useful to Research Officers themselves, to their assistants and to visiting consultants--will also be discussed. For example, it appears that record keeping would be simpler if all rows grown in any one season were numbered consecutively, rather than starting with row 1 (one) again each time parentage changes. Other details will also be discussed.

For F2 populations now growing in Field 12, all plants should be harvested, except those that are very small and produce essentially no seed. Few plants will provide enough seed to plant a row. Therefore, I recommend that the F3 generation be grown in plant-progeny hills--8 to 10 seeds for each F2 plant in a separate hill. Hills should be 18 to 24 inches apart in rows that are 30 inches apart. The exact spacing of hills within rows may be governed by what can be managed easiest.

Eight to ten plants per hill will allow observers to evaluate the genotype (to a degree) in 1974. The best one, two, or three plants from the best appearing hills can then be harvested to provide additional breeding stocks.

F3 rows in Field 12 should be handled in a similar manner, because of the low seed yield per plant. However, 10 plants from each F3 row may adequately sample the genetic variation in the row. Some rows do not have 10 plants.

All F1 plants should be harvested. Then F2 populations will be smaller than is desirable.

Harvesting of rows and individual plants should be done as plants mature and seeds become dry enough for safe storage. It would be well to schedule harvest dates at 3- or 4-day intervals when plants begin to mature.

Some F2 populations contain very late flowering plants that will be useful in future breeding work. If they are not good as varieties <u>per se</u>, they well could be good parental stocks. Late flowering plants are often severely damaged by stinkbugs. Stinkbugs puncture pods and feed on seeds. Care must be taken to prevent serious losses from stinkbug feeding.

The INTSOY variety trial is now scheduled for Ebini. A second trial may also be scheduled at another location. The 1973 INTSOY variety-trial instructions provided for the substitution of as many as 4 (four) local varieties. I presume the 1974 instructions will permit the substitution of some entries, but perhaps

fewer than four. The selections [illegible] x Jupiter that are being multiplied at the east end of Field [illegible] logical choices to include. They are the only selections for which [illegible] seed is likely to be available.

They should be substituted only if good quality seed is harvested. Seed from several rows (from the same F4 source) will have to be bulked to provide enough planting seed. These F4 sources were chosen in October 1973 because plants in them looked uniform. I presume they were also among the best appearing rows in the 1973 nursery. If the latter is true, these lines should yield more than any other entry in the INTSOY variety trials with the possible exception of Jupiter. If they do not, the breeding effort in Guyana over the past three years has not been as effective as we expected it to be. If it is practical to do so, I suggest that no fewer than two lines from F67-1533 x Jupiter be substituted into the INTSOY trials.

Addendum [illegible] Attachment B

March 9, 1974

Field assignments have been made for the April-May planting season. Present schedules place soybean research plots in fields having soil traits similar to those in Field 12, but the area may have slightly better internal drainage. I recommended that Mr. Nwasike take soil samples immediately to determine lime and fertilizer needs, and that he apply needed lime as soon as possible.

Further recommendations were: (1) once a field is identified as being satisfactory for soybeans, use it several consecutive seasons. This recommendation is based on the observation that soybeans in Field 38 (beginning with Dr. Chetram's work three or four years ago) generally increased in growth and productivity each succeeding season. (2) When soybean plots are moved to a new field location, anticipate the move one year in advance and grow nonresearch soybeans to build up Rhizobium japonicum populations prior to the time the field is devoted to research plots.

Field 38 is located on a sand reef. This fact plus the consecutive soybeans referred to above probably account for the good growth and productivity observed by Dr. Carl Hittle in October 1973 (see his trip report). Another trip report suggests that sand reef soil is the best place for soybean production on the coast. This appears to be a correct assessment, probably because of its slightly higher elevation and its slightly courser texture.

ATTACHMENT C

Observations at Kibilibiri

The immediate problem is how best to harvest, process, and store seeds for an April-May planting. About 150 acres of Jupiter were planted in November and December. Plants from the early November planting are now maturing. Stands are very thin; plants are short; and yields are low.

Plants from the December plantings will mature in late March or early April. Stands are better; plants are slightly taller; yield per acre probably will be better if subsequent dry weather does not reduce yield appreciably; but some fields are very weedy. Grass between rows in some fields is as tall as the soybeans. There is little or no grass in rows. Unless the grass is killed by dry weather, herbicides (Paraquat) or something else, it will be difficult to harvest at all, and particularly difficult to harvest seed that will be suitable for planting.

The harvesting procedure now in progress (beginning February 28) is to cut plants with machetes, let them dry in the field a few hours, then haul them to the combine for threshing. This procedure appears necessary, because plants are too short, too widely spaced, and have too many green pods and stems for efficient field combining. (Green stems and pods appear to be the result of inadequate pod set.) One batch of seed in the combine hopper on the morning of March 7 probably was in excess of 20% moisture. High humidity, the threat of showers, and the need for obtaining the maximum number of seeds suitable for use in April-May plantings lead decision makers to prefer seed drying over longer field drying.

One lot of seed was being dried in a peanut wagon. A thermometer placed in the seed lot registered 100°F. Outside air temperature was about 85°F. Seed moisture after 6 to 8 hours of drying was near the level for safe storage. The moisture meter at Kibilibiri was inoperative. Seeds looked fairly good.

Projected acreages for April and May plantings are about 1,000 acres at Kibilibiri and a total of about 200 acres at several coastal sites. Careful harvesting, processing, and storage of essentially all of the present production will be necessary to provide adequate planting seed for projected plantings.

So far as we know, Jupiter is the best variety for production at Kibilibiri. However, a variety that would be about 6 inches taller and require no longer time from planting to maturity would be better for the November to April season. Prior observations of breeding stocks suggested that such a variety could be forthcoming. Jupiter, in the April-May plantings, grows taller, however some height increase may be needed here also. In all plantings at Kibilibiri, the observed (and expected) time from planting to maturity is about 120 days. In our first plot observations at Ebini, Jupiter matured in about 105 days. We have no explanation for this apparent shift.

Weeds (grass) between rows of the December planting probably could have been controlled by timely cultivation. If skilled decision-making personnel are on hand at all times, and if the machinery works properly, troublesome situations such as this one can be prevented as more experience is gained.

Recommendations:

1. Continue day-to-day decisions on time of harvest, length of field drying time, etc. All personnel recognize that more field drying is needed but that unpredictable showers will have a detrimental effect on seed quality. Thus, no rigid procedures will serve all situations equally well.

2. Because weather conditions and other factors will vary, all seed lots cannot be handled uniformly. Tag each days harvest with a different lot number, record data on all variables associated with each seed lot, and test germination percentage on each lot separately. Such data may help identify factors that reduce germination percentages most, and they may be useful to the Seed Technologist who will visit Guyana later. Germination percentages should indicate planting rates for next season, and they should also indicate if different seed lots should be planted at different rates. (A more detailed pencil copy of this recommendation was left with George Eason.)

3. Develop better seed technology for all phases from pre-harvest through planting. A visiting Seed Technologist should make many valuable recommendations. Some on-site research may be required.

4. Anticipate difficulties further in advance and take corrective action. For example, the grass in row middles of the December plantings will cause serious harvesting problems. It probably could have been controlled by one cultivation when it was about 2 inches tall. On-site management decisions will be necessary to handle such situations.

5. In the breeding program now in progress at Mon Repos, recognize that varieties taller than Jupiter will be needed for good production in the November-March season at Kibilibiri. Selection criteria should be later flowering and rapid early season growth in both determinate and indeterminate growth types. Also recognize that a type well suited to Kilbilibiri may lodge excessively at Mon Repos in environments that produce luxuriant growth.

Other Observations

On March 6, Mr. Don Yearwood stated that he originally obtained some red-brown soybean seeds from southeastern U.S. and planted them on his farm near Ituni before he had learned anything about inoculant. He said his plants nodulated. The paper by Chesney (Agron. J. 65: 887-889) implies nitrogen fixation without applied inoculant at Matthews Ridge. There may be several good explanations for nodulation without inoculation (if it occurred). However, one possible explanation is that some native legume in certain parts of Guyana cross inoculates with soybeans. Is this possibility worth checking out? Ituni probably is about 25 miles from Kibilibiri, where yellow soybeans leaves observed in 1971 apparently were associated with poor nodulation.

TRIP REPORT - GUYANA

Date Submitted: August 1, 1974

NAME: Carl N. Hittle

TITLE: Professor of Agronomy

DIV/UNIT: INTSOY (International Soybean Program)
Department of Agronomy, University of Illinois
Urbana, Illinois 61801

PERIOD OF TRAVEL (Inclusive Dates): April 25 to May 13, 1974

ITINERARY: See Attachment A (Travel to Guyana under Task Order No. of Basic Ordering Agreement No. AID/CM/TA-BOA-73-30). Attachment used to include details of itinerary with time schedules.

PURPOSE:

1. To make a second, follow up visit to Guyana as coordinator and crop improvement specialist of Task Order No. 1 (see Trip Report-Guyana, C. N. Hittle, Period of Travel - September 25 to October 12, 1973).

2. To deliver soybean seed of two INTSOY variety trials to Guyana and to assist in detailed planning for properly conducting these trials.

3. To review the progress, priorities and goods of Task Order No. 1 with appropriate Ministry of Agriculture and USAID personnel.

4. To expedite the procurement and shipping of the puffing gun which General Foods, through A. I. Nelson, was making available to Guyana.

5. To coordinate follow up visits of the consultants.

6. To give limited assistance to planning for demonstration, extension-type soybean plantings in Guyana.

7. To assist in the further assessment of potential soybean production areas in Guyana and to give assistance and encouragement to researchers and growers in areas with good to high production potential.

8. To discuss future soybean production research in Guyana.

ORGANIZATIONS AND PERSONS CONTACTED:

Officials and personnel of the Ministry of National Development and Agriculture, the Central Agricultural Station (Mon Repos), The Booker Group, the Ebini Research Station, the Kibilibiri Station, the Mathew's Ridge Development Scheme, Robert R. Nathan Associates, the USAID Mission to Guyana and other appropriate organizations.

(See Attachment B for detailed listing).

RESULTS/ACCOMPLISHMENTS:

1. Transported soybean seed for two varietal trials from University of Illinois to Guyana. Assisted in detailed planning for these trials. Each trial consists of 15 varieties, 4 replicates per trial. Trial locations are Mon Repos (near Georgetown) and Ebini.

2. Assisted in completing arrangements for the Food and Nutrition Development Unit to receive a puffing gun.

3. Assisted in site selections for the planting of the breeding and variety trials.

4. Visited the Blairmont Estate and discussed details of proposed 20 acre soybean planting.

5. Assisted in the collection of peat samples in order that complete analyses could be made at Soil Testing Laboratory, Department of Agronomy, University of Illinois.

6. Discussed, in some detail, the future plans of the seed processing center; especially in relation to the forthcoming visit of the seed processing specialist.

7. Presented a seminar on "Soybeans - the Protein Hope of the Future."

8. Visited Kibilibiri and the Mathew's Ridge complex and discussed priorities, problems and possible solutions to some of the problems.

9. Detailed proposals for various agronomic trials were left with the staff at Mon Repos.

(See Attachment A for additional details).

FOLLOW UP ACTION REQUIRED AND RECOMMENDATIONS:

1. Continued efforts will be made to arrange for follow up visits of INTSOY technicians so they will be in Guyana at an optimum or near-optimum time in relation to project activities.

2. More soybean cultural trials are needed and will be conducted as soon as they can be planned and adequate personnel can be made available for the operation of such trials. In the meantime, a bulletin is being prepared, by Mon Repos, on the "Package of Practices" for soybean production. The "Package of Practices" will be modified in accordance with additional research information; as it becomes available.

3. Additional equipment is needed at Kibilibiri, Ebini and Mon Repos. Only very limited funding is provided in Task Order No. 1 for equipment. It is suggested that Guyana personnel develop equipment lists which will then be reviewed by INTSOY consultants. Appropriate measures can then be taken in an attempt to generate funds for equipment.

4. All personnel associated with soybean development in Guyana are encouraged to review previous soybean reports. These reports include the following:

   a. Plans and procedures for the prodiction of soybeans - Kibilibiri - K. Hinson and Gordon Price.
   b. Suggested procedures for expanding soybean acreage on virgin savannah soil at Kibilibiri in 1972 - K. Hinson.
   c. 1970 soybean variety trials at Ebini - K. Hinson.

   d. Circular S-217 - Florida Agr. Exp. Sta. - Jupiter - New Soybean variety for tropical latitudes, June, 1972.
   e. Various reports on soybeans and other crops by Carl Hazenberg.
   f. 1973-74 Trip Reports of Forster Davidson, S. W. Williams, A. I. Nelson, Scott Cramer, Kuell Hinson, and Carl N. Hittle.

Some of the recommendations and suggestions in these reports, which would accelerate and strengthen the soybean program, are not being followed. Periodic review of key reports should reduce the possibility of "oversight" relative to the implementation of recommended practices.

5. The extension component of the soybean development program needs strengthening. Promising varieties should be planted in demonstration plantings in areas of potential soybean production. Cooperators should be chosen well in advance of intended planting date. Maximum assistance should be extended to those farms where the demonstration trials are located.

   Task Order No. 1 does not provide for an extension specialist. Therefore, the extension assistance which can be provided by INTSOY is minimal.

6. More intensive and aggressive planning for the training of Guyanese personnel in soybean research, production and extension is needed. Task Order No. 1 does not provide finances for the training of local personnel. However, INTSOY personnel can assist in (a) selection of persons to be trained, (b) suggesting location(s) and duration of training, and (c) making contacts with universities and the organizations where training is to be received. It is emphasized that short courses on soybean production and food utilization are planned for the summer of 1975 at the University of Illinois.

7. If Ebini is to become a major "crops" research center, at least some resident professional personnel are needed at that location. In my judgment, it is unrealistic to conduct plant breeding and agronomic research at Ebini with all the professional staff stationed in Georgetown (Mon Repos).

8. In many of the operations at Mon Repos, Ebini, Kibilibiri and Mathew's Ridge more attention needs to be given to organizational details and to getting jobs done at the right time.

DISTRIBUTION:

Ministry of National Development and Agriculture/Guyana - 5 copies (Attention: Mr. Ben Carter)

Central Agricultural Station, Mon Repos - 5 copies (Attention: Dr. Alfred V. Downer)

AID/Guyana - 5 copies

AID/Washington - 5 copies

University of Illinois - 15 copies (Internal Distribution)

ATTACHMENTS:

A - Detailed itinerary and schedule of activities

B - Organizations and persons contacted

C - Analyses of peat from Guyana

ATTACHMENT A - GUYANA TRIP

DETAILED ITINERARY AND SCHEDULE OF ACTIVITIES

April 25, 1974

By plane from Port of Spain, Trinidad to Georgetown, Guyana. 1905/2020

April 26, 1974

Meeting with George Eason, Fred Marti, and Christian Nwasike. Some of the details of Professor A. I. Nelson's report were discussed since an early decision was necessary relative to the interest in Guyana in taking advantage of the offer from General Foods to receive, without cost, a "puffing gun." It was decided that the final decision relative to the procurement of the puffing gun and other matters related to Food Technology would be decided on Monday, April 29, in a meeting with Ben Carter and Reginald Clarke.

Since George Eason was leaving Guyana on April 27 and was not to return until approximately May 15, detailed discussions were held with him. These discussions included (1) a review of the progress, priorities and goals of Task Order No. 1; (2) the timing of follow-up visits of the technicians; (3) a tentative scheduling of activities during my present visit; (4) an assessment of the present situation at Kibilibiri and Ebini, and (5) contacts which should be made relative to soybean extension and demonstration plantings. George Eason indicated that Dr. Fred Marti, USAID Agricultural Economist, who recently arrived in Guyana, was vitally interested and heavily involved in the Guyana soybean program and would also assist INTSOY personnel with their activities.

April 27, 1974

Traveled by vehicle with Richard G. Wheeler and John C. Beyer, Senior Associates with Robert R. Nathan Associates, Inc., to the coastal area between the Demerara and the Essequibo Rivers. We took the ferry across the Demerara River at Georgetown and traveled via the coastal road to Parika; then south along the east bank of the Essequibo River, going as far as the road would permit which is about half way between Parika and Bartiga. The coastal area from Georgetown to Parika is devoted largely to rice farming and I was surprised to see that rice is harvested with large self-propelled combines. The area along the east bank of the Essequibo River is devoted to mixed farming including a relatively large number of food crops such as cassava, tomatoes, yams, bananas, plantains, and other vegetable crops. Most of this area is subject to flooding and inadequate drainage is a common problem. In the entire area which we visited on April 27 there does not appear to be much potential for a crop such as soybeans.

April 29, 1974

Meeting at the Ministry of Agriculture with Ben Carter, Reginald Clarke, H. A. D. Chesney, Christian Nwasike, and Fred Marti. The Ministry of Agriculture personnel indicated a definite interest in receiving the puffing gun from General Foods and suggested a telegram be sent immediately indicating this intent. Gratitude was expressed for the detailed trip report which had recently been submitted by A. I. Nelson, along with the useful information included as attach-

ment. The Ministry of Agriculture also appreciates the fact that Professor Nelson made arrangements for Guyana to receive the puffing gun.

Other details of INTSOY activities were discussed with Mr. Carter.

After the meeting with Ministry of Agriculture personnel, a telegram was sent to INTSOY indicating that Guyana would like to receive the puffing gun from General Foods. USAID/Guyana agreed to bear the cost of packing, shipping, and handling of the puffing gun from Battle Creek, Michigan, to Georgetown, Guyana.

April 30, 1974

A.M. Additional detailed discussions with USAID personnel relative to scheduling for the remainder of the week, and additional arrangements relative to the shipment of the puffing gun.

P.M. To Mon Repos - Visited with Dr. Alfred V. Downer, Christian Nwasike, Herman Adams, and Harry Persaud. The site where the soybean varietal and breeding trials will be planted in May was visited. The soybean trials will be planted in area No. 38 and four "plots" have been plowed. The present soil conditions are very dry and the soil will have to be worked several times before a suitable seedbed can be prepared. Soil samples were taken on April 30 and Dr. Theodore Hubbard indicated that results of the soil tests will be available within one week. Some of the details of the breeding program were discussed with Christian Nwasike and Herman Adams.

May 1, 1974

A Guyanese Holiday, Labor Day.

Spent the entire day reviewing pertinent information and reports relative to the Guyana Soybean Program.

May 2, 1974

In the company of Fred Marti, Christian Nwasike, and Herman Adams traveled to Blairmont Estates, Ltd., which is a 10,000-acre sugarcane estate, near New Amsterdam. The purpose of this visit was to observe the site which had been selected at Blairmont Estate for the planting of approximately 20 acres of soybeans and to discuss the details of this planting with personnel of Blairmont Estate. Dr. Marti, Christian Nwasike, and George Eason had visited the site the previous week and had discussed some of the details of this demonstration planting. The soil analysis from the area where soybeans are to be planted indicates organic matter as follows: 2.2 percent in the 0- to 6-inch layer and 1.1 percent in the 6- to 12-inch layer. The soil type is a heavy, silty clay loam. PH values are as follows:

Soil depth	pH
0 to 6 inches	4.5
6 to 12 inches	4.6
12 to 18 inches	4.75
18 to 24 inches	5.45

On May 2, two tons of finely ground limestone were being applied to the plots. The rows are to be 21 inches apart with one seed to be planted every 2.5 to 3 inches. Seed of Jupiter soybeans and Nitragin inoculant are being furnished by the Central Agricultural Station at Mon Repos.

On May 2, the condition of the seedbed was not good. The land area had previously been in pasture and land preparation had been difficult; with excessive soil moisture during land preparation. The physical condition of the soil was not desirable for sowing soybeans. The soil clay particles were very large and chunky and could not be broken up into smaller particles. Ditches were being dug throughout the area to facilitate drainage during periods of excess rain.

The field selected and the soil conditions were not optimum for the growing of soybeans. However, these are conditions which are typical of the coastal area.

It is not clear, to this technician, who, in the Ministry of Agriculture, is responsible (or is to be responsible) for assisting with extension-type demonstration soybean plantings, such as the one at Blairmont Estate. Obviously, if the private and/or public sector are to succeed in soybean production, they need considerable assistance from both research and extension personnel, who are familiar with the soybean plant and its cultural requirements.

In Scott Cramer's trip report, he indicated that 40 farmers would be picked by Government Extension personnel for the planting of 20 acres. As of May 2 I do not believe these farmers had been selected. Further discussions will be held with the Ministry of Agriculture relative to the soybean extension program.

In evening. Visited with Dr. C. Henry, CARICOM Secretariat, Georgetown.

May 3, 1974

Traveled by chartered plane with Herman Adams, Fred Marti, Christian Nwasike, Nazim Kazim and pilot Henry Fitt to Kibilibiri and Ebini. One hundred and fifty acres of soybeans have been grown at Kibilibiri during the past season. Apparently most of this acreage was planted the latter part of December. All but 65 acres have been harvested. The 65 acres were being harvested on May 3. Jupiter soybeans were very short, approximately one foot in height, and were shattering very badly. We were informed that the soybeans should have been harvested approximately one month previously. In many instances probably more than 50 percent of the soybeans had already shattered and fallen to the ground. The first pod-bearing nodes are very low on the plants and the combine head is missing many of the pods. Due to inclement weather, weeds and other difficulties, harvesting has been difficult at Kibilibiri. It is hoped that enough seed can be harvested for the planting of 1,000 acres of soybeans in May, 1974. Due to uneven ripening and high moisture content, many of the soybeans at Kibilibiri were harvested by hand, with hand sickles, and taken to the drying shed or to the driers for further drying before being run through a combine. In other instances, the soybeans were harvested by hand, piled in the field to dry, and were then fed through the combine. Kibilibiri has a large continous drier which is being set up, but is not yet operative. They also have a big drier for batch drying which can be connected to wagons with false bottoms. However, this drier was not working properly due to lack of

parts for the diesel burner. Rather than operating it with diesel fuel for which it was designed, they had been burning wood and using the fan of the drier to force the warm air through the soybeans.

It is obvious that Kibilibiri needs considerable technical assistance relative to (1) improved agronomic practices for soybean production, (2) threshing, (3) seed drying, (4) seed handling, and (5) seed storage.

The only soybean planting presently growing at Ebini is a very small trial designed to study the effects of nitrogen and phosphorus fertilizer on Rhizobium japonican nodulation. There is a very poor stand of soybeans in this trial which will limit the meaningful information which can be obtained from the trial. Nodule determinations have been made but yields will not be determined because of poor stands. The entire experimental soybean area will be prepared in the very near future for the planting of an INTSOY varietal trial at this location. The trial will not be planted until there is adequate rain. Presently the soil conditions at Ebini are extremely dry.

An INTSOY varietal trial will also be planted at Mon Repos.

May 4, 1974

A seminar on "Soybeans - The Protein Hope of the Future" was presented at the Public Service Training Center in Georgetown. There were approximately 25 in attendance. The seminar, including the question and discussion period, lasted from 9:30 to 11:30 a.m. Most of those in attendance were from the experiment station at Mon Repos and the Ministry of Agriculture. This illustrated seminar included (1) results from soybean production research programs at the University of Illinois and the U. S. Regional Soybean Laboratory, (2) an indication of the objectives and capabilities of INTSOY, (3) some results of the 1973 INTSOY varietal trials, and (4) results from the soybean program in India. Special emphasis was given to the role and importance of Rhizobium japonicum and to soybean seed quality.

May 6, 1974

A.M.

Conference with Jonathan Harlow and Ray Wilkens of Bookers. The Blairmont Estate, near New Amsterdam, is operated by Bookers and is where approximately 20 acres of soybeans will be planted. Dr. Abdul H. Wahab will join Bookers in July, 1974 to assist in their agricultural research and development program. Dr. Wahab received his Ph.D. from Iowa State University and has worked on the development of the soybean seedling. Dr. Wahab will not only be of considerable value to the Booker program, but will also be able to give assistance to the Guyana Soybean Development Program. Booker Estates are keenly interested in taking a "hard look" at any new crop such as soybeans. With the present prices of urea and other forms of nitrogen, there is considerable interest in a re-evaluation of green manure crops as a source of nitrogen for the sugar cane. Blairmont Estates intends to go ahead with the planting of the 20 acres of soybeans as soon as there is sufficient soil moisture.

P.M.

To Mon Repos. Held detailed discussions with R. E. Fletcher, Christian Nwasike, and Harry Persaud. The Kibilibiri project is composed of 237 square miles or 151,680 acres. This includes both wooded areas and savannahs. The total cultivatible area is about 2,500 acres. This past season there were about 550 acres of crops including 150 acres of soybeans, 225 acres of corn, 125 acres of black-eyed peas, and 50 acres of peanuts. The discussions suggested that the two most important problems relative to soybean production are (1) getting and maintaining adequate stands and (2) harvesting problems. Associated with stand difficulties are poor seed quality, unfavorable weather conditions at planting time, and weed competition. Harvesting problems are caused by adverse weather conditions and "machinery problems." In some instances, the lack of a skilled operator on the combine is a limiting factor. Usually the soybeans at Kibilibiri are cultivated only once. Planovin is used as a pre-emergent herbicide.

Soybeans growing at Mathew's Ridge are mainly a "small farmer's" crop. It is felt that transportation is no more of a problem at Mathew's Ridge than at Kibilibiri. Harvesting and handling of soybeans may be limiting factors. Approximately 35 acres of soybeans were just harvested at Mathew's Ridge. It is anticipated that 100 acres will be planted in the near future on the Ministry of Agriculture farm. Mr. Fletcher is much more optimistic about soybeans on the intermediate savannahs than on the coastal areas. The outlay for fertilizer and other imports on the intermediate savannahs should be more than justified by the soybean yields obtained. The possibility of growing soybeans on "slash/burn" areas was discussed. It was suggested that the economic feasibility of such a practice will depend on how many soybean crops can be obtained before the area goes back to bush. With additional fertilizer it was suggested that the area could be maintained as long or longer than production on the intermediate savannahs.

On the intermediate savannah, the original pH is approximately 4.4. "This can be raised to 5.8 to 6.0 with only one ton of limestone. However, the pH drops rapidly in two years. Therefore, liming is necessary every two or three years." At Kibilibiri ordinary limestone seems to be doing a better job than dolomitic limestone. It is believed that there is no aluminum toxicity problems at Kibilibiri and that manganese deficiency is not a problem. However, there is some evidence that zinc and boron deficiencies are present. A basal treatment of trace EL plus borax and zinc oxide have been used for many of the plantings at Kibilibiri. There are frequent delays in planting, processing, seed drying, etc. at Kibilibiri because of lack of spare parts or inability to get spare parts in a relatively short period of time. Some people suggest that Kibilibiri is too mechanized. However, for a large operation they only have a few days in which to work the land or harvest a crop and it takes considerable mechanization to accomplish these operations on a timely basis. At Kibilibiri there are about 75 people employed. Forty percent are temporary and 60 percent are semipermanent or permanent employees. There are about 20 housing units at Kibilibiri. The biggest need at Kibilibiri is for skilled operators and mechanics.

People at Ebini seem to be happier than those at Kibilibiri. Living conditions at Ebini are somewhat better, the families are more settled, and the people and the system at Ebini came up under a different type of development and social structure. At Ebini, the emphasis has been on a research station; at Kibilibiri the emphasis has been on maximum production of the various crops.

Mr. Fletcher is optimistic about corn production at Kibilibiri. In the difficult seasons it has produced at least something, whereas some of the other crops have failed completely. The Global Agri Industries, Ltd. at Kibilibiri is still under the control of the Ministry of Agriculture. There is some talk that Kibilibiri, and units like it, might be placed under a "cooperative" autonomous unit which would take it out from under the Ministry of Agriculture. This might have certain advantages and certain incentives for making it a more efficient and profitable unit.

It is obvious that additional equipment is needed at Mon Repos, Kibilibiri and Ebini. For example, there is no refrigeration at Kibilibiri for storing soybean inoculant. Likewise there is no refrigeration at Ebini for such purposes. Proper seed storage facilities are not present at either Kibilibiri or Ebini. Controlled temperature and humidity for seed storage are vitally needed at both locations.

May 7, 1974

A.M.

Meeting with John Browman, FAO (Extension). Mr. Browman indicated that the soybeans at Mathew's Ridge had already been harvested and that arrangements are now being made for the next planting. He further indicated that farmers have not yet been selected for this year's demonstration plantings (see Scott Cramer's trip report). The soybean demonstration plots will be part of a much bigger program including the vegetable crops and selection of farmers for the various demonstration plantings of the various crops will be decided in the immediate future. Mr. Browman then made detailed arrangements for Fred Marti, R. E. Fletcher, Herman Adams, Mallory Davis, and C. N. Hittle to visit Mathew's Ridge on May 8, 1974.

P.M.

To Mon Repos for discussions with Chris Nwasike and others. Harry Persaud, microbiologist, and I then proceeded to the "peat bog Mahaicony." Mr. Persaud estimated that in this region there are over 100 square miles of peat bog, which is called "pegase" in Guyana. After hiking on a canal bank for about one mile, peat samples were taken from the bogs by going into the area several hundred yards before digging. Samples were taken at four levels; 0 to 6 inches, 6 to 12 inches, 12 to 18 inches, and 18 to 24 inches. These samples will be dried and taken to the Agronomy Department Soil Testing Laboratory, University of Illinois for complete analyses. Mr. Persaud is providing as much detail as possible on the peat bog areas (See Attachment C for analyses of the peat).

May 8, 1974

By chartered plane to Mathew's Ridge. Flight time from Georgetown to Mathew's Ridge is approximately 1 hour and ten minutes. After leaving the Essequibo River, one flies over very dense jungle. Very few settlements are noted during the entire route.

The Mathew's Ridge complex is an interesting development. At one time, manganese was mined in this area. However, apparently due to the expense of the mining operation, the mining of manganese was abandoned. Since that time agricultural development has been attempted for the area. There are about 3,000 people living in the Mathew's Ridge complex, which includes Mathew's Ridge, Port Kaituma, and Arakake. There are about 1,000 acres under cultivation, with an additional 1,000 acres in pasture. Presently,there are approximately 800 beef cattle in the settlement and slightly over 80 dairy cattle. Residents are encouraged to develop their own farms under more or less a homestead arrangement. A farmer will be given a 25-acre plot and three acres will be cleared by the project. For the next crop it is anticipated that the following acres will be planted in the settlement (most of these acres will be planted in May, 1974). Corn, 475 acres; sorghum, 10 acres; black-eyed peas, 20 acres; red beans (kidney beans), 10 acres; mung, 10 acres; soybeans, 36 acres; pigeon peas, 25 acres; citrus, 62 acres;avocado, 10 acres; mixed fruit, 15 acres, plantains, 12 acres; sweet potatoes, 16 acres; bitter cassava, 216 acres; yams, 20 acres; and tumeric, 40 acres. In addition there will be small acreages of other horticultural and fruit crops planted.

We were told that the average land clearing costs are $300 Guyanese per acre ($150 U. S. per acre). On the settlement there is considerable construction under way for the National Service volunteers to be housed. It is estimated that as soon as this construction is completed that from 60 to 70 National Service volunteers will be brought to Mathew's Ridge. Mathew's Ridge and Port Kaituma are connected by both a railroad and a highway. It is 32 miles to Port Kaituma. From Port Kaituma all produce can be loaded on a boat and then transported to Georgetown or other places by water. The area where soybeans are to be planted at Mathew's Ridge looked very good. The soil is friable, the slope is good, and drainage should be no problem. Of course, appreciable quantities of both limestone and fertilizer will be needed.

After visiting Mathew's Ridge, we flew to Port Kaituma. In this area they plan to grow some soybeans and the land which had been prepared for soybeans and/or black-eyed peas was most impressive. The soil is very friable, reddish brown in color, apparently has some organic matter, and it had been well prepared. The slope is gentle. Due to excessive rainfall at this location, approximately 120 inches annually, the agricultural officer intends to plant soybeans and black-eyed peas on raised beds. These beds will be similar to the raised beds which are presently used for cassava. Beds are eight to ten feet in width. Here also the soils are low in pH and limestone and fertilizer are a necessity for suitable crop yields. We saw samples of a considerable number of vegetable crops which were growing quite well at Port Kaituma. These included black-eyed peas, red kidney beans, lima beans, cabbage, peppers, eddoes, tannias, sweet potatoes, cassava, yams, and dasheen. The general conditions at Mathew's Ridge suggest that considerable more soybean research is in order. The biggest limitations will probably be (1) sufficient dry weather during maturation and harvesting and (2) the high cost of limestone, fertilizers and chemicals for weed and insect control.

May 9, 1974

At Georgetown. Made contact with personnel of Diamond Estates who are planning to grow 20 acres of soybeans this year. Unfortunately, after making contact, there was insufficient time to travel to this site, which is on the east bank of the Demerara River and is very near where Diamond Estates have 150 acres of oil palm.

Reviewed additional reports at USAID Mission "Memory Bank" and started drafting trip report and recommendations.

May 10, 1974

At Mon Repos, had detailed discussions with personnel associated with the soybean plant breeding and variety testing program. It was emphasized that the seed packaging and timely planting of the basic plant breeding materials, which has come from Kuell Hinson's program, is to receive top priority and will have priority over the two INTSOY varietal trials. The number of seeds from each breeding line was determined and assistance was given in heling to determine which entries would go in the observation trials and which entries would go into the replicated yield test. In most instances, there is not as much seed as there was anticipated at the time of Dr. Hinson's visit. After the breeding trials are planted, then the two INTSOY trials are to be planted at Mon Repos and Ebini. At Mon Repos the four "plots" in area 38, which are allotted for soybeans, are each approximately 20 feet wide and 500 feet long. One of these plots should accomodate the INTSOY variety trial.

Had detailed discussions at noon, with Dr. and Mrs. Timothy Wall, relative to the use of soybeans on the Seventh Day Adventist Mission property, which is on the east bank of the Demerara River.

Visited Harry Madramootoo, Director of Research of the Guyana Rice Corporation, relative to his recommendation on the possibility of Guyana receiving assistance, on a very practical and applied production basis, in soybean production from a person who had previously assisted the Guyana Rice Corporation.

Visited with H. A. D. Chesney, Ministry of Agriculture. Discussions with Lawrence Peterson and Fred Marti of the USAID Mission.

May 11, 1974

At Mon Repos. Attended the weekly seminar. The topic of discussion on May 11 was "Cotton Trials at Ebini." The seminar was presented by Nazim Kazim.

Held discussions with Neville C. McAndrew, relative to seed production, processing, storage and distribution; with special attention given to the details of the forthcoming visit of the seed specialist who is a member of the Mississippi State University Seed Technology Laboratory. Since Mon Repos is in the process of relocating much of their seed processing equipment to a new building, it was agreed that the staff at Mon Repos would submit the detailed diagrams of where the seed processing equipment was to be located. These details were to be sent to C. N. Hittle, who would then discuss them with the seed processing specialist at MSU. It is anticipated that the seed processing specialist from MSU will visit Guyana in July or August.

The School of Agriculture at Mon Repos was visited. This school is adjacent to the Central Agricultural Station where a two-year program in agriculture is offered. Included in facilities at the School of Agriculture are a food processing center, some land for the raising of crops, and an animal science unit with chickens, dairy cattle and swine operations. These facilities and operations not only provide practical experience for the students but also provide income for the School of Agriculture.

May 13, 1974

A.M.
Visited Food Processing Center, Ruimveldt Industrial Park, with Fred Marti. Construction is still in progress at the Center. A roof is being constructed above the open space, between two of the units, to provide additional space for the Food Processing Center. At the time of our visit, apparently due to construction, none of the food processing machinery was in operation. It is anticipated that the pre-heater, puffing gun, expansion chamber, etc. will be installed at the Food Processing Center.

P.M.
Departed Georgetown, Guyana for Puerto Rico.

ATTACHMENT B - GUYANA

ORGANIZATIONS AND PERSONS CONTACTED

Ministry of National Development and Agriculture

Ben W. Carter, Chief Agricultural Officer
H. A. D. Chesney, Deputy Chief Agricultural Officer
Mohammed Naseer, Senior Economist
Reginald Clarke, Food and Nutrition Development Unit
Peter Fernandes, Veterinarian
John Browman, Principal Agr. Officer, Extension

Central Agricultural Station, Mon Repos

Alfred V. Downer, Principal Agricultural Officer
R. E. Fletcher
Christian Nwasike
Nazim Kazim
Harry Persaud
Herman Adams
C. J. Mulelr
Neville C. McAndrew
Mr. Wharton
Mr. Mangra
Soni Persaud
Theodore Hubbard

Booker Group

Ray Wilkens, Project Evaluation Unit
Jonathan Harlow, Project Evaluation Unit
Winston E. H. Tyrell, Blairmont Estate
Evan Foster, Blairmont Estate
John Piggott, Blairmont Estate

Ebini Research Station

Noel Holder, Livestock Officer and Director
Earl Munroe, Soybean Research
Clive Fraser, Corn Research

Kibilibiri - Global Agricultural Industries, Ltd.

Keith Gordon, Assistant Site Manager

Mathew's Ridge, Arakake, Port Kaituma

Henry Cameron
S. G. Yaw
Ramnarine
Oscar Adams
Jerry Ifill

USAID Mission, Guyana

Lawrence L. Peterson, Director, Acting
Alan I. Vestrich, Program Officer
Ronald E. Ullrich, Assistant Program Officer
Warren H. Frayne, Accountant
Quentin J. Wildman, Engr. and Capital Development
George S. Eason, Food and Agr. Officer
Fred Martin, Agr. Economist
Lyndal R. Ashcraft, Executive Officer

Robert R. Nathan Associates, Inc.

John C. Beyer, Senior Associate
Richard G. Wheeler, Senior Associate and Production Economist
William F. Burke, Agronomist
Oswald P. Blaich, Team Leader

Parsons, Brinckerhoff, Quade and Douglas, Inc. - Engineers

Douglas M. Dodds, Resident Manager
Abdul R. Sukkariyyah
Robert B. Lutz

Other

C. Henry, CARICOM Secretariat, Georgetown
Richard D. Bowers, Agriculturalist, British High Commission, O.D.A.
(Assisting with developments and research at Mon Repos and Kibilibiri)
Harry Madramootoo, Director of Research, Guyana Rice Corporation
Gad Bachrach, Sec., The Israel Inst. of Transportaiton, Planning and Research
Mallory Davis, Texas A & M, Tropical Livestock Production, 211d Consortium
Ralph May, Purdue University, Tropical Livestock Production, 211d Consortium
Glen Howze, Tuskeegee, Tropical Livestock Production, 211d Consortium

ATTACHMENT C - GUYANA

INFORMATION ON GUYANA PEAT

ORIGIN: Soil Type 20. Anira Peat.

OCCURRENCE: Demerara Water Conservancy, West of Mahaica and South of Cane Grove.

Anira peat is a very poorly drained organic soil more than 30" 'thick' consisting of very dark brown to reddish brown, partly decomposed peat surface and dark reddish brown peat subsoil.

The soil contains many leaves, roots and plant stems, is very strongly acid and may contain thin lenses of mineral soil material. With drainage the soil may sink by about 50% and would be susceptible to burning. The underlying material is a soft greenish gray clay which usually contains acid sulphates.

PEAT ANALYSIS: (Analysis made at Mon Repos, Georgetown, Guyana)

Constituent	Average values
Organic matter	67%
Nitrogen	1.25%
Phosphorous	18 mg/100 g
pH	3.7
Sulphur	125 mg/100 g
KCl Acids	2.5 me/100 g

The above data were obtained using a composite sample.

Determinations Made by Soil Testing Laboratory, Agronomy Department, University of Illinois, on Guyana Peat Samples.

	Depth of Sampling			
	0-6"	6-12"	12-18"	18-24"
pH	3.7	3.3	3.3	4.0
% ash	0.8	0.4	0.15	0.13
Total sulfur %	0.23	0.26	0.39	0.40
Phosphorus %	0.20	0.18	0.09	0.07
Potassium %	0.44	0.33	0.25	0.25
Calcium %	0.05	0.05	0.05	0.05
Magnesium %	0.04	0.04	0.05	0.10
Manganese ppm	5	5	5	5
Iron ppm	600	3792	1096	1006
Boron ppm	27	21	4	3
Zinc ppm	17	13	6	5
Copper ppm	12	8	4	7
Aluminum ppm	3000	2148	469	489
Sodium ppm	485	287	110	50
Silica %	4.08	1.63	0.22	0.34
Nitrogen %	1.30	1.28	1.31	1.78 (this is total N by Kjeldahl)

TRIP REPORT

Guyana

Date Submitted: 2 September 1974

NAME: A. H. Boyd

TITLE: Assistant Professor of Agronomy-Seed Technology
Mississippi State University

DIV/UNIT: INTSOY (International Soybean Program)
University of Illinois, Urbana, Illinois

PERIOD OF TRAVEL: 10 August 1974 - 26 August 1974

ITINERARY: See Attachment A

PURPOSE:

1. To review the soybean seed production and processing situation.

2. To evaluate problems related to soybean seeds and make appropriate recommendations.

3. To give seminar on seed handling to interested persons in the Ministry of Agriculture and Central Experiment Station. See attachment B for summary sheet.

ORGANIZATIONS AND PERSONS CONTACTED:

USAID/Guyana, Central Experiment Station, Ministry of Agriculture/Guyana, Blairmont Sugar Estate, Global Agri Industries.

Note: See attachment C for list.

RESULTS AND ACCOMPLISHMENTS:

1. Visited Central Experiment Station, fields in the frontland clay soils and the intermediate savannahs. Reviewed the crops and seed production situation.

2. Discussed seed problems with plant breeders and seed production-processing personnel. Made suggestions and recommendations as appropriate (see comments and recommendations).

3. Presented seminar on seed drying and processing to USAID and Central Experiment Station personnel at Mon Repos.

4. Gave interim report to Mr. George Eason, USAID and Mr. Ben Carter, Chief Agriculture officer Guyana, on last day of work in country.

OBSERVATIONS AND COMMENTS:

GENERAL:

The projected plantings of soybeans have not materialized in the 1974 rainy season. While we cannot pinpoint all the reasons for the small plantings, difficulty in land preparation and poor stands attributable to weather conditions and/or poor seeds are obviously important factors. Fields that emerged to a good stand and were planted in the early part of the rainy season appear to have good growth and pod set. Fields, notably at Kibilibiri, which were not planted until late June have not yet flowered. Unless the August and September rains are unusually good it is unlikely that enough soil moisture will be available for a very good harvest in this area. The following table gives the locations of production fields and my estimate of production.

Guyana Soybean Production estimate:

Location	Acres	Yield/a	Est. Bu.
Blairmont Estate	5	15	75
Mon Repos	4	25	100
Kibilibiri			
Good Stand	50	20	1,000
Poor Stand	70	10	760
Total:	135		1,935 bu.

Since these estimates are only from personal visual inspection they may be off considerably but the large one, Kibilibiri, is more likely to be too high than too low if normal rainfall patterns prevail.

One of the major problems observed in the frontland clays was reduced stand and plant growth in poorly drained spots in the fields. Soybeans will grow on the very heavy soils but there must be particular attention paid to drainage all the way from the first land preparation through growth of the crop. On the basis of experience on similar soils and topography in the Mississippi Delta, I suspect that planting on rows or ridges will help greatly. This will allow cutting a system of water furrows across the field to drain the small depressions. The major drainage systems are excellent, it is the small areas that hold water often less than an inch deep that are giving the problems.

Another problem reported in all these fields was the difficulty of getting seeds planted and covered to a uniform depth. This can be alleviated by better, smoother land preparation. In addition the use of planters with double disc openers rather than sword openers will probably help. The double disc openers are on equipment used at Kibilibiri but not on the planter used for the coastal plantings.

Weed growth is very rapid and only fields with vigorous soybean plant growth to shade the ground completely are free of serious weed problems on the coast. The vigorous growth of sedges will create serious problems for combine harvesting. The cutter-bar of the machine will have to be in good condition to prevent choking. At Kibilibiri the weed problems are not so severe but there should be investigation on control practices at all locations.

Mon Repos:

The seed section at the central experimental station is organized to support the plant breeding and research activities of the station. Mr. Neville McAndrew is in charge of the section and is assisted by Mr. Sonny Persaud. They are charged with all seed processing, storage, and testing for the station and are the ones who should be in a position to take initiative in offering training for extension or farm management personnel and recommendations on program development to the administration. In this area, Mr. McAndrew has prepared a proposal for a program which is discussed more fully under program development.

Facilities:

The storage and processing facilities are being expanded at this time with addition of a 60' x 80' cement warehouse attached to the side of the old structure. The old structure is approximately 60' x 120' containing space for drying, equipment and tool storage, two air conditioned seed storage rooms and a seed laboratory.

EQUIPENT

	Unit	Manufacturer	Condition
1.	Diesel drying unit	R. A. Lister & Co. Gloucestershire, England	Good
2.	Electric onion seed dryer	Locally fabricated	Repairable
3.	Air screen cleaner 147B Clipper	A. T. Ferrell & Co.	Good
4.	Air-screen cleaner Vac-A-Way	Hance, Ohio USA	Good
5.	Seed grader	Ce-Co-Co	Good
6.	Scalper No. 1297-1 Clipper	A. T. Ferrell & Co.	Good
7.	Gravity table SS&S V-155A	Sutton Steel & Steele Houston, TX, USA	Needs repair, replacement decks & Canvas

8.	Corn sheller	Ransomes	Fair
9.	Peanut sheller	Ce-Co-Co	Fair
10.	Seed treater Gustafson BS	Gustafson Mfg. Co. Thief River Falls, Minn., USA	Good
11.	Heat sealer	Thames Bag Sealer Co.	Good
12.	Moisture tester	Burrows, Chicago, Ill., USA	Good
13.	Germinator Burrows 1875	Burrows	Good
14.	Germinator (incubator adapted)	Gallenkamph	Good
15.	Vita-scaope	Burrows	Good
16.	Seales 550g capacity	Burrows	Good

Remarks on equipment and its utilization:

Item 1:

The lister dryer unit is excellent and is reportedly in good condition. The Lister Diesel engines have a reputation for durability so it should operate for many years if reasonable maintenance producers are carried out. For proper utilization of this unit a raised platform or plenum chamber should be built so that air from the units can be forced through bags placed on the platform. Sides and ends are, of course, enclosed so that air can only pass through the bags. Mr. McAndrew has one design for such a system and an alternate one will be mailed to him. The space available will be adequate for expected drying needs for some years at Mon Repos but will not utilize the drying unit to its maximum.

Item 2:

The electric onion seed dryer is a small electric unit that has not been used for some time. It appears to be repairable with little difficulty and should be utilized for small (2 to 20 pounds) research lots of seed.

Item 3:

The Clipper model 147-B air screen cleaner appears to be in good condition but it is being under-utilized by only using one of the three screens that should be in the cleaner. New screens are on order so that the proper top screens will be available for soybeans. When they arrive it is important that they be used and the workers instructed in its operation. This cleaner, with good maintenance, should last many years and provide adequate capacity to accomplish the mission of the seed section at Mon Repos.

Item 4:

The Hance Vac-A-Way is a table-top size air-screen cleaner that is utilized and does an excellent job on small lots of seed.

Item 5:

The Ce-Co-Co seed grader consists of a fan system and bottom grader system. If the 147-B air-screen cleaner is operated properly on soybeans there should be no need to use it. At present it is being used as an additional step from the air-screen cleaner.

Item 6:

The scalper should not be needed for soybeans. It is used mostly for sorghum.

Item 7:

The gravity table is a table-top model which is unlikely to have utilization in soybean processing. It needs a new screen wire deck for larger seeds, the existing cloth dick needs re-covering, and a canvas connector "boot" needs repair.

Item 8 & 9:

Appear to be adequate for the needs.

Item 10:

The seed treater is of ample capacity and in good condition.

Item 11:

The heat sealer unit will be needed for sealing seeds in plastic bags for storage and shipment.

Item 12:

12 thru 16 are all in good repair and appear adequate for the 100-200 samples, a month reportedly tested by this laboratory. Somewhat larger working space would be most welcome.

Kibilibiri:

The commercial production venture at Kibilibiri currently consists of about 1500 acres of cleared land. About 126 acres were planted to soybeans in late June with only about 50 acres up to a good stand. The other acres had emergence problems but at this time it is impossible to pinpoint the exact reasons for the failure. Probably it was a combination of high soil temperatures, rainfall factors and weak seeds. The only way to be sure of the major weaknesses in the planting and emergence period will be very close supervision by Management and technical people during these operations.

At the above location there is a peanut (wagon bed) dryer with four wagons which should be more than adequate for good soybean seed drying. For the coming harvest(s) they should dry their seed soybeans to 12% or less moisture and ship immediately to Mon Repos. Mr. McAndrew will

process and store all possible in conditioned storage, the rest he processed and dried down to 10.5% and packaged in moisture vapor barrier bags.

As Kibilibiri progresses in soybean planting, they should be encouraged to handle their own processing and storage. The equipment should not be elaborate. An air-screen cleaner equivalent to the 147-B clipper at Mon Repos and bagging equipment should suffice.

Matthews' Ridge:

Matthews' Ridge area was not visited but from information gained it is suggested that no seed production be attempted from this site until sufficient production of commercial soybeans has developed to justify installation of a small cleaning and drying facility as indicated for Kibilibiri. It is assumed that drying is available for commercial soybeans at each site.

Blairmont Estate:

Blairmont is the only private production visited. The production field consisted of only about 5 acres but parts of it look promising. It is recommended to Blairmont that they rogue a part of their field to keep for seed production (this is being done). This consultant feels strongly that private producers, such as, Blairmont should develop their own capability of maintaining planting stocks from season to season as they develop in commercial production.

Program Development:

Seed program development often is thought of as seed certification, however, it must encompass much more. It must entail regulation,

education, production, marketing and transportation to name a few. Seed certification is an educational, quality control and sometimes marketing tool of a seed program.

Attention is called to a seminar presented by Mr. Neville McAndrew at Central Agricultural Station entitled - "Production Processing, Storage and Distribution of Planting Material in Guyana" in which he points out that there is no organized seed industry in Guyana and presents proposal for implementation of a program in three phases. His proposal encompasses all seed materials as a comprehensive program should. Efforts are fragmented too much if each commodity group embarks on its own seed program. They are to some extent in phase 1 now in that planning and first efforts are beginning. For the present with the limited personnel available, I feel that these people should continue efforts towards seed production development and training rather than put too much effort into preparations for passing laws. As production momentum is gained then regulatory procedures can be applied.

Training of personnel for extension and production organizations is of major importance. Some long term degree training at seed oriented Universities should be considered. Short term training in the U.S. is also available. The Seed Technology Laboratory, Mississippi State University, has a special Seed Improvement Short Course for Foreign Participants each summer sponsored by USAID and listed in their literature. Some Ministry people, such as, McAndrew, Persaud or extension personnel could make good use of this course. Of prime importance however, is in-country training conducted by indigenous personnel or foreign technicians utilizing local facilities. For short term effect 1

or 2 days "seed appreciation" seminars help direct administration and technical thinking towards the importance of seed preservation and quality. It is suggested that part of the time of a later visit by a seed technology specialist be devoted to assist in some local training at Mon Repos.

SUMMARY OF RECOMMENDATIONS:

1. Mon Repos should provide seed processing and storage services for commercial seeds only to the extent of capacity of existing seed cleaner.

2. Kibilibiri and Matthews' Ridge or other large isolated units should move towards self sufficiency with small farm type cleaners.

3. If seed demands develop beyond the capacities of the above units to supply, then other more elaborate facilities should be con-structed to supply the demand on an economically viable basis.

4. Major efforts of the Ministry of Agriculture should continue to be directed towards increasing production rather than immediate passage of a seed law.

5. Training of field and extension personnel should begin as soon as possible on seed harvest, drying, processing and storage.

6. Short term (12-16 weeks) training in the U.S. should be considered for 2 or 3 Ministry or extension people.

7. Major efforts should be placed on agronomic research in seedbed preparation, planting techniques and weed control, especially on the frontland clays.

8. Since no conditioned storage is available, seeds to be held in open storage should be dried to 10.5% moisture and sealed in 6 mil or heavier polyethylene bags.

9. The seed section should immediately begin investigation of sealed bag storage, best moisture content, and packaging materials for preservation of local soybean varieties.

10. Close watch and personal observation should be kept by the soybean specialist and the seed section during planting time to be able to "trouble shoot" problems when they arise.

11. Blairmont and other private producers should be encouraged to save their own planting seeds for educational as well as logistical reasons.

DISTRIBUTION:

Ministry of National Development and Agriculture/Guyana - 5 copies (Attn: Mr. Ben Carter)

AID/Guyana - 5 copies

AID/WAshington - 5 copies (Attn: Mr. George Parman)

University of Illinois - 15 copies (internal distribution)

ATTACHMENT A

Itinerary: A. H. Boyd, consultant Seed Technology
INTSOY (International Soybean Program)
University of Illinois at Champaign-Urbana

Date/Time		Activity
10 Aug.	1100	Leave San Jose Costa Rica
	1330	Leave airport in Costa Rica for Caracas
	2030 PM	Arrive Caracas Venezuela
11 Aug.	0800	Leave Caracas
	0930	Arrive Port-of-Spain Trinidad-Tobago Layover 1 day visit with Chaguaramas Agricultural Development Project.
12 Aug.	0800	Attempts to contact Lawrence Cross by cable and telephone were futile due to communications workers strike. As last resort a taxi was hired to go to Ministry of Agriculture and finally to the Development Project.
	1030	Arrive at Chaguaramas
	2030	Return to Port-of-Spain
13 Aug.	0830	Leave Trinidad for Guyana
	1000	Arrive Temerihi airport Guyana
	1100	Check in with USAID/Georgetown
	PM	Visit Central Experiment Station at Mon Repos. Discuss the INTSOY program and soybean seed problems with research and administrative staff (see Attachment B).
14 Aug.	AM	Meeting with Ben Carter, Chief Agricultural Officer, Ministry of Agriculture/Guyana. Discussed plan of work and the soybean grain and seed production situation. Accompanied by Dr. Fred Marti USAID.

*12 August covered by separate trip report.

15 Aug.		Visit Blairmont sugar estate, observe experimental fields of soybeans on frontland clays. Discussed seed preservation problems and cultural practices with Mr. John Piggott and other management personnel.
16 Aug.		Visit Herman Adams, soybean breeder. Inspect soybean breeding plots and INTSOY trials. Discuss various lines and recommend a screening system for seed quality differences in similar lines.
17 Aug.		Review work and begin formulating recommendations.
18 Aug.		Preparation of Seminar.
19 Aug.		Visit Kibilibiri production farm and Ebini Experiment Station on the intermediate savanna. Accompanied by Mr. George Eason (RDO-USAID) and Ben Carter (MIN/AG).
20 Aug.		Visit Central Experiment Station, Mon Repos. Review seed processing, storage, and testing facilities, arrange time and facilities for seminar.
21 Aug.		Prepare seminar, have typing done at AID offices, work on final recommendations.
22 Aug.		Visit Central Experiment Station, Mon Repos for further in-depth discussions on soybean production and seed handling. Prepare interim report for USAID/Guyana.
23 Aug.		Final interview with Ben Carter to discuss status and needs of the soybean program. Present seminar to 15 of professional staff at Central Experiment Station and 2 USAID officers.
24 Aug.	1000	Leave Georgetown Guyana
	1245	Arrive Barbados, Layover because connections all way home not available.
25 Aug.	0855	Leave Barbados

	1250	Arrive San Juan Puerto Rico
	2000	Leave San Juan
	2330	Arrive Atlanta, GA.
26 Aug.	1240	Leave Atlanta, GA.
	1335	Arrive Golden Triangle Airport
	1430	Arrive Starkville, MS.

ATTACHMENT B

SUMMARY SHEET

Soybean Seed Drying and Processing

by

A. H. Boyd - Consultant for INTSOY
(International Soybean Program -
University of Illinois Champaign - Urbana

We are interested in soybeans but our primary interest is providing adequate food for our people. We hope that soybeans will help us bridge the gap between hunger and plenty in the tropics as it has in temperate zones. To successfully produce them in a tropical environment such as Guyana, it will be necessary to adapt new production techniques and cultural practices.

After the plant breeder has developed adapted varieties, agronomic research and some mistakes in the fields teach us how to grow the crop commercially. When we reach this point, we must be prepared to handle the crop and provide adequate quantities of high quality seed stocks to maintain the momentum of development.

Our discussion today is limited to drying and processing, but we should not lose sight of harvesting, storage, transportation and marketing of seed as important and necessary activities in a complete seed industry.

Drying:

Soybean seed drying is less understood than cereal crop drying. Few people have experience or research data on the subject. However, drying is a necessity for production and preservation of quality seeds under the climatic conditions of Guyana. Removing seeds from the unfavorable

high moisture environment in the field and quickly drying them minimizes seed respiration, halts multiplication of fungi, and results in higher quality seeds with minimum infestation of storage and fungi entering storage.

On the basis of our research experience in production, and information available in the literature, we can be confident of the following recommendations for drying soybean seed in Guyana;

General statements and recommendations on soybean seed drying:

1. Drying should be started within a few hours of harvest. The shorter the holding period - the better. Seeds should not be held overnight at high moisture without drying in progress.

2. Maximum air temperature entering the dryer should not exceed $105^{o}F$.

3. The actual determining factor for temperature setting should be the relative humidity (RH) of the drying air. 40% RH minimum, 60% RH maximum.

4. The lower the RH of the drying air, the faster drying progresses.

5. The greater the airflow (within reasonable limit), the faster drying progresses.

6. Drying should be completed in no more than 24-36 hours for best seed quality.

7. Too rapid drying (drying with too much heat or too low RH air) causes seed coat and cotyledon cracking, thus poor germination.

8. Over drying (too low RH air) causes excessive seed cracking and poor storability. Soybeans should not be dryed below 8.5% moisture. This damage may not be apparent to visual inspection.

9. If seeds are to be placed in moisture proof bags such as polyethylene, the moiture content should not be above 10.5%.

10. If initial seed moisture is above 17% an air flow of at least 10 CFM/bu of seed is necessary.

11. At lower moisture content proportionally lower air flows are acceptable but not necessarily desirable.

12. Do not shut down dryers at nights and weekends until seeds are dry.

Processing:

What is soybean seed processing? We think immediately of passing the seeds through a machine that we call a seed cleaner and obtaining first class planting seed. Actually, the process is not very complicated but neither is it quite so simple nor so sure.

Processing encompasses:

- Drying and aeration
- Handling and conveying
- Cleaning and sizing
- Upgrading
- Treating
- Packaging

We may have various reasons for processing seeds, basically to:

- Achieve quality standards
- Condition seed
- Improve mechanical purity
- Improve germination
- Improve plantability
- Improve appearance
- Protect

Pre-processing factors;

- Weed control
- Harvest:
  - Time
  - Method
- Handling Method:
  - Bulk
  - Bags
- Pre-cleaning

Sequence for processing seed:

- Pre-cleaning examination
- Removal of undesirable materials
- Upgrading and/or sizing
- Treating - if necessary
- Packaging

Some problems to consider:

- Quantity or quality
- Mechanical mixtures
- Mechanical damage
- Efficiency

- Pollution
- Safety

Keys to effective processing:

- Start with good viable seed
- Knowledge of seed and contaminants
- Knowledge of principles of processing
- Proper equipment
- Operational skill
- Adequate attention
- Patience
- A lot of common-sense.

ATTACHMENT C

Persons Contacted:

USAID:

Lawerence L. Peterson	Mission Director
C. Albert Calderia	Asst. Mission Director
George Eason	Rural Development Officer
Fred Marti	Agricultural Advisor

Ministry of National Development and Agriculture:

Ben Carter	Chief Agricultural Officer
Staff	Ibini research station Global Agri Industries, Kibilibiri

Central Experiment Station Staff, Mon Repos

Mr. R. E. Fletcher	Agronomist/Acting Agriculture Officer
Mr. H. Adams	Project Team Leader for Soybeans
Mr. C. Nwasike	Project Team Leader for Corn
Miss A. P. Stephenson	Agronomist/Project Team Leader for Black eye
Mr. Harry Persaud	Microbiologist - Crop Science Division
Mr. N. C. McAndrew	Agricultural Officer - Crop Science Division

Private:

John Piggot & Staff	Blairmont Sugar Estates Ltd.

TRIP REPORT - GUYANA

Date Submitted: October 1, 1974

Name: Kuell Hinson

Title: University of Illinois - Consultant

Div./Unit: INTSOY, University of Illinois, Urbana, Illinois, 61801

Period of Travel (inclusive dates): September 7 to September 14, 1974

Purpose: To evaluate soybean breeding stocks, variety trials, and production fields, and make recommendations for further work including selection of types for variety release.

Itinerary:

9/7 Arrived Georgetown at 1700.

9/8 Worked on correspondence and reports.

9/9 Met with George Eason and Fred Marti (USAID) briefly and planned itinerary for first part of week. Accompanied Dr. Marti to Booker offices for a brief meeting with Mr. Jonathan Harlow (Business analyst) and Dr. Abdul H. Wahab (Crop Development Officer). Went to Mon Repos, met with Dr. Downer (Principal Agricultural Officer, Crops, MA), delivered seed of non-nodulating Hardee to Harry Persaud, met Herman Adams and Christian Nwasike (Crops Officers, MA), looked over soybean field plots with Mr. Nwasike remainder of morning (about 1½ hours). Spent entire afternoon in soybean field plots with Mr. Nwasike and Mr. Adams.

9/10 Observed about 4 acres of Jupiter seed production at Blairmont Estates (one of 13 Booker sugar plantations) with Dr. Abdul Wahab (Bookers), John Piggott (Bookers), Fred Marti (USAID), and Herman Adams (MA).

9/11 Visited Ebini with Mr. Christian Nwasike and Mr. Herman Adams (MA), returned between 1 and 2 pm, spent remainder of day discussing plant breeding with Nwasike and Adams, further obser-

vation of plots, and observing 3 acres of Jupiter increase at Mon Repos.

9/12 Visited Matthews Ridge with Mr. Christian Nwasike and Mr. Herman Adams (MA), and Mr. George Eason (USAID). Returned for a late afternoon conference with Mr. B. W. Carter, Chief Agricultural Officer (MA).

9/13 Presented seminar at Mon Repos which was attended by about 12 persons on the research staff.

Departed Georgetown 13:30 hours - Arrived Miami 23:30.

9/14 AM - Worked on report of observations, recommendations, etc., attached.

PM - Returned to Gainesville 16:00 hours.

I. Research Plots at Mon Repos

Research plots at Mon Repos looked very good, considering the near disastrous performance the previous season. Some INTSOY plots, planted May 28, had been harvested on September 9, but border rows remained for observation. Among varieties from northern U.S., Williams looked best. Among varieties from southern U.S., Bossier looked best. However, all U.S. varieties were too short for commercial production. Jupiter and two local entries (replacing Calland and Semmes) were clearly the outstanding entries. Jupiter is one parent of both local entries. Both are similar to Jupiter in growth and yield. Carefully collected yield data will be needed to determine if either is superior to Jupiter. A disadvantage for the local entries is that neither can be easily distinguished from Jupiter by any obvious morphological or genetic trait.

A four-replicate yield test of 18 determinate entries (including a Jupiter check) in one-row plots also looked very good. All entries have Jupiter as one parent. All are similar to Jupiter in growth traits. There is variation among entries in plant height and pubescence color. There may also be variation in maturity date and lodging. The taller entries will be better adapted to long-day production in the savannahs, provided they equal or exceed Jupiter in yield. Jupiter is often below optimum height there. The shorter entries should not be discarded yet, unless they are low in yield, because the optimum plant type for coastal plantings has not been determined. The shorter types in this nursery are only slightly shorter than Jupiter. In coastal production on high-fertility soil in narrow rows, some shorter types may perform better than Jupiter.

The better determinate entries probably will be in the same general yield class with Jupiter. Extensive data from yield tests probably will be necessary to identify types having the best yield potential. Therefore, careful attention should be given to lodging, shattering, etc. as supplementary selection criteria.

Another 22 entries (mostly indeterminate) were planted in one-row plots and replicated four times, when there was enough seed. They are too tall and lodge too much for mechanized production on fertile, coastal soil. The better entries are potentially well adapted to the short-day season in the savannahs. Mr. Adams should eliminate obviously low yielding types and test other entries at Ebini (and Mon Repos) during the short-day season, with PI 240664, Improved Pelican, and Jupiter as checks. PI 240664 and Improved Pelican were the best indeterminate varieties available when the Guyana breeding program was started. The yield increase of selections, over PI 240664 and Improved Pelican, will be a measure of the progress made to date in indeterminate types.

Small F_3 populations were growing. Several F_3 plants contain traits that are different from Jupiter. These should be propogated if yield is in the general range of Jupiter. Although progeny from these plants most likely will not be good enough for variety release, their unusual traits may make them valuable sources of variation in future breeding work. For example, crosses of these types with Bossier would be expected to produce progeny that would be adapted to both savannah and coastal soils.

A few crosses, between V-1 and one or more of the tall, late-maturing types were made at Mon Repos. Relatively large F_2 populations will be needed to produce the range of segregates needed for effective selection. A large F_2 population would be 4000 plants. A smaller population of 1000 plants would provide a fairly good sample of variability. We had smaller F_2 populations of Jupiter x F65-170, Jupiter x F66-1534, and Jupiter x F67-1533 in 1972, only because we did not have enough F_2 seed for a larger population. Although apparent progress has been made from the small F_2 populations used, we were undoubtedly handicapped considerably by population size. Guyana researchers should avoid similar handicaps when it is possible to do so.

II. Blairmont Estates

Bookers are attempting soybean production for the first time. They have 4 to 5 acres of nearly mature Jupiter at Blairmont Estates (across the Berbice river from New Amsterdam) in a renovated pasture on coastal clay soil. It is very difficult to prepare a good seedbed in such soil unless rainfall is optimum. A poor seedbed, dry soil following planting, and perhaps weak seed caused poor stands in their first plantings. (However, seed from the same seedlot gave good stands at Mon Repos when planted with adequate soil moisture).

In subsequent plantings good stands were obtained with heavier seeding rates. Final acreage was about one-fourth that originally planned. Fertilization was 2T/A limestone, 200 lbs/A Triple superphosphate, 100 lbs/A muriate of potash, and 20 lbs/A urea. Row width averaged 21 inches from two passes of 42-inch equipment. Plants eventually covered row-middles well and shaded out late developing weeds. Earlier weed growth was controlled by hand cutting.

Some plants were mature on September 10, whereas others were two weeks or more from maturity. There was no obvious evidence that diseases hastened maturity. Genetic differences in maturity are smaller than observed differences. Thus some stress factor, probably associated with water relations, evidently caused non-uniform maturity. If all harvest is delayed until the latest plants mature, seed quality of early maturing plants will be lowered.

Expected yield at Blairmont is 25 to 30 bushels per acre. The potential for the soil is somewhat more. The same factors that hastened maturity of some plants probably will reduce overall yield. Narrow row-canopies suggest that a stress factor was present. Potential stress factors are excess soil moisture when plants were small, delayed nodulation (4 weeks after planting), inadequate potassium (unless native soil potassium was high), and inadequate soil aeration.

Blairmont (Booker) personnel appear pleased with the prospect for soybeans. They plan to harvest all current production for planting seed. They have the potential for producing about 14,000 acres yearly on land that is normally idle for 9 months between the time the last sugarcane ratoon crop is harvested and a new sugarcane crop is started. Previously, the land was flooded for this 9-month period. Dr. Wahab mentioned difficulties associated

with reversing irrigation pumps, but I did not get the full significance of this.

For a higher production potential at Blairmont, and on similar soils, the following procedures may give better results, if it is possible to use them. Some may be in use already.

1. Treat planting seed with a appropriate fungicide.

2. Apply granular inoculant, at higher bacterial rates than can be stuck on seeds, at or slightly below the seed depth. (Seed depth should be 1 to 1½ inches). Apply granular inoculant one (1) inch below seed, provided seed remain in contact with firm, moist soil. Otherwise, apply inoculant at seed depth.

3. Plant on small ridges to prevent excess moisture around germinating seed and roots of young seedlings when nodules should be forming.

4. Aerate roots when plants are approaching flowering, by chiseling alternate row middles 6 to 8 inches deep with a narrow chisel. Then chisel undisturbed row middles 7 to 10 days later. This procedure has worked well on central Florida soils that are tightly compacted. It should be tried experimentally on the coastal soils of Guyana, particularly where plants are not on ridges.

5. Adjust row widths so the above operations can be performed easily with machinery. If growth of Jupiter is not reduced by slow nodulation or some other stress factor, leaves should cover the middles of 30-inch rows (perhaps wider) by the time plants flower.

6. Recheck fertilizer inputs. The potassium in 100 lbs/A muriate of potash is equal to the potassium in only 20 to 25 bushels of soybean seed.

III. Ebini

The INTSOY trial, planted at Ebini on June 11, was 92 days old when observed. Some plots of northern U.S. varieties matured 73 days after planting. Plots of Bossier, Improved Pelican, and Hardee (Group VIII), were mature or maturing. Plants of Improved Pelican looked relatively better at Ebini than on the coast. Bossier looked good at both locations, except for being too short. This suggests that Bossier would be a good parent in crosses made to develop tropical varieties, provided the other parent has adequate late-maturity traits.

Results from a nitrogen rate study and a within-row spacing study are likely to be inconclusive, because of inadequate stands. Researchers should resist the temptation to correct for poor stands. Experience has shown that over correction is the general rule.

Sheet erosion at Ebini contributed significantly to poor stands. Grass waterways are recommended for carrying water from fields that are similar to the one currently in use at Ebini. Small, lateral, temporary ditches may also be needed to carry water to the grass waterways. Grass will be necessary in waterways carrying appreciable quantities of water to prevent more serious erosion.

IV. Matthews Ridge

Reports indicate 45 acres of Jupiter at Matthews Ridge. We did not see all 45 acres. Planting dates ranged from June 17 to August 28. Jupiter planted on June 17 had stem lengths of about 36 inches. Plants observed were dark green, despite the fact that no inoculant was applied. Soybeans had previously been grown in the field we observed. Nodulation was rather sparse. Unless a high percentage of nodules broke off when we pulled plants, the number and size of nodules was generally less than one normally expects on plants as green as these were. This suggests the possibility for a highly effective strain of Rhizobium japonicum in these soils. We suggested that Mr. Harry Persaud establish a culture from these nodules.

The range in planting date is not serious, because there is no well-defined dry season at Matthews Ridge.

The soil at Matthews Ridge is well suited to soybean culture. The appearance of the plant canopy suggested a yield of 40 to 50 bushels per acre, but podset was inadequate for this yield level. Plants were still flowering at 87 days after planting and there were small pods in addition to full length pods. On the coast, plants only slightly older had stopped flowering and had well-developed seed. If these plants eventually produce 40 or more bushels per acre, the growing period probably will be significantly longer than for the coastal area. The reason for this, if it proves to be the rule, should be investigated. Matthews Ridge is about 1° latitude further north, thus has longer days. However, the difference in day length ordinarily would not be expected to cause the difference in growth, flowering, etc. that appeared to exist between Matthews Ridge and the coast.

The native pH of Matthews Ridge soils is 4.0 to 4.5. Two tons per acre dolomitic limestone was added. This was expected to raise soil pH to between 5.0 and 6.0. Other fertilizers added were: 33 lbs/A urea, 200 lbs/A triple superphosphate, and 200 lbs/A muriate of Potash. The nitrogen in the urea was not enough to delay nodulation appreciably or to impart the dark green color observed.

Much of the current production at Matthews Ridge will be harvested for planting seed. The goal for the area is 500 acres by one year from now. It is expected to be produced primarily by hand labor. Production will be moved nearer Port Kaituma, where the soil is sandier and fields are leveler. The absence of a predictable dry period for harvest will make seed shelling and drying difficult. Otherwise the Matthews Ridge-Port Kaituma area appears to be a very good location for soybean production.

V. Nitrogen, Inoculants, and Nodulation

Good, early nodulation from applied inoculants is generally more difficult to obtain in the tropics than in temperate regions. Economic considerations suggest that tropical-grown soybeans must depend primarily on symbiotic fixation for their nitrogen. Experiments in the U.S. suggest that total nitrogen fixed is correlated with early onset of symbiotic fixation. Therefore, fertilizer nitrogen, if used at all, should be at rates that will not delay nodule formation and nitrogen fixation. Up to 20 lbs/A N may be beneficial on savannah soil. On coastal soils, particularly following sugarcane, it probably would be best to apply no nitrogen.

Treatment of planting seed with fungicides probably will need to be adopted as a standard practice in Guyana. All seed-treatment fungicides are detrimental to Rhizobia placed on seeds, but some are more detrimental than others. Further, when soybean seeds germinate, the seed coat is often lifted nearer the soil surface. Inoculants applied to the seed coat may be lifted with it. These considerations suggest that relatively few Rhizobium japonicum organisms will be in a position to infect the first potential nodule sites. The delay in nodule formation at Blairmont Estates (4 weeks from planting) suggests that one or more of these factors may have operated. However, at Blairmont the 4-inch rain that fell soon after planting (and subsequent rains) may have water-logged the soil enough to delay nodule formation.

On the savannah soil the situation is different. Soils have very good external and internal drainage. The absence of rain, rather than its presence, is likely to be a deterrent to good nodulation. Dry soil after planting may get hot enough to kill seed-borne Rhizobia, particularly if seeds are shallow and if the seed coat is lifted in germination.

The above considerations suggest the need for granular inoculant applied through a granular applicator separate from the seed. In Central Florida granular inoculant has given good results on first-year soybeans where no method of seed inoculation was satisfactory. The central Florida soil referred to is somewhat similar to savannah soil in texture. We believe it would be well to at least explore the potential for granular inoculants in Guyana.

In a conversation with Harry Persaud (Soil Microbiologist, MA) on September 11, Persaud said that he did not know about granular inoculant. It would seem desirable that the Soil Microbiologist who next visits Guyana should be prepared to help Harry Persaud establish procedures for making granular inoculant. If such cannot be done, consideration should be given to sending Mr. Persaud to a location where granular inoculants are made so he can learn techniques of production.

Granular inoculant has at least three major advantages: (1) more Rhizobia can be applied than can be stuck on seeds, (2) Rhizobia have little or no direct contact with seed-treatment fungicides, and (3) granular inoculant can be applied below the seed depth where it is protected more from high surface-soil temperatures. Further, the first potential nodule sites are slightly below the seed depth.

Frozen broth cultures of Rhizobia have similar advantages, but the mechanics of handling them are somewhat more complicated.

VI. Seed Multiplication and Variety Release

A. Determinate types:

The 18 entries in the 4-replicate variety test of determinate types contain nearly all of the remaining near-homozygous selections. A few others for which insufficient seed were available for replicated testing may be added. These selections appear uniform enough for release as varieties. However, care should be taken to not release types that are heterogeneous for maturity date, because seed on early-maturing plants will be subject to infection by microorganisms before later maturing plants are ready for harvest. This will cause problems similar to those now prevailing at Blairmont, presumably from nongenetic causes.

The 18 determinate entries are similar to Jupiter in growth and yield. An analysis of variance on yield data probably will identify 2 or 3 as inferior to Jupiter. I doubt if there will be significant differences among other entries. This suggests that extensive variety testing will be necessary to identify superior yielding selections (if they exist) and that factors such as lodging, seed holding, seed quality, canopy cover, plant height, height of lowest pods, etc. should be considered along with yield data in making final selections.

Subsequent testing should be in 4-row plots so that these traits can be observed in situations that more nearly represent a production field. Shattering data can be collected from border rows at intervals after the center rows are harvested for yield.

Concurrent with subsequent testing in plots, seed increases of a few selections that appear superior can be made for field-scale tests. The ease with which a selection can be managed in a production field may be the ultimate factor determining which selection should be released. Since the selections are so similar, careful record keeping and tagging will be necessary for accurate identification. Further, the responsible Research Officer (presumably Mr. Adams) should maintain seed stocks of known identity as breeder seed stocks.

One or more gray pubescent types are included in potential releases. If all other factors are equal, the release of a gray pubescent type would be preferable, because it can be readily distinguished from Jupiter.

In choosing selections for advancing to field-scale trials (if this procedure is followed), yield will be the major selection criteria. However, if yield and other traits are nearly equal, a range in height and maturity should be represented. It is likely that two or more determinate varieties (with different plant heights when grown in the same environment) will maximize the

production potential for Guyana. For example, a variety with plants of adequate height for savannah soils during the short-day season will likely be too tall (thus lodge excessively) on coastal soils during long days. A variety with height adaptation to savannah soils during long days probably will have height adaptation to coastal soils during short days. Varieties well adapted to mechanized farming on the coast probably will be equally well adapted to mechanized farming in the Northwest District (Matthews Ridge). However, Matthews Ridge production is likely to be primarily by hand labor, which suggests a different growth type.

Row width will influence variety adaptation. In general, as row width is narrowed, a shorter growing variety becomes equally well or better adapted. Researchers should keep in mind that there is nothing magic about the 60 cm row width recommended for INTSOY variety trials. The row width at which leaves overlap in row middles at early podset generally is best. This will vary with varieties. In mechanized farming, row width may be determined to a considerable extent by the equipment used. This could have a very significant influence on which selections will perform best. Thus, advancing selections with a range in growth traits becomes important from management considerations as well as from day-length and soil-type considerations.

B. Indeterminate types:

Nearly all indeterminate types now growing at Mon Repos are too tall and lodge excessively in their present environment. However, they do have potential for at least two production situations in Guyana. One is the short-day season on savannah soils. Another is for hand labor situations on almost any soil type. There may be others.

During the 1973-74 short-day season at Kibilibiri, Jupiter attained only about one-half the plant height needed for shading weeds in row middles and for efficient combine harvesting. Unless or until a determinate variety is developed that will produce 4 to 6 more nodes than Jupiter produced, indeterminate types probably will perform best. It may be that indeterminate types will continue to be best for this particular environment, because a determinate type that makes adequate vegetative growth may require a growing season that is too long to coincide with the length of time adequate soil moisture is available.

Another place for indeterminate varieties is where hand labor is used in planting and harvesting. Spaced hills of indeterminate types will yield about as much per acre as solid seedings of the best adapted determinate types. The within-row spacing should be determined for each production situation. It probably will range from 8 to 24 inches, with 2 or 3 plants per hill (to insure having at least one plant per hill). Planting and harvesting will be more rapid in spaced hills than in solid seedings when all work is done by hand. When plants are mature, the harvester can grasp all plants in a hill with one hand and with one stroke of a cutlass "harvest" 500 to 1000 (or more) unshelled seed. These taller growing more branched indeterminate plants will be easier to transport to a shelling (threshing) location than shorter, more compact, determinate plants. However, it is also possible that a tall, determinate type would be best for the hand-labor production envisioned for Matthews Ridge. Both types should be used initially. Experience will determine the better type.

Because the optimum plant type for the various production situations in Guyana must be determined by experimentation, it is important that a wide range of plant types be developed and maintained by the breeder.

Since present plans are to use hand labor for soybean production in the Matthews Ridge-Port Kaituma area, within row spacing experiments should be initiated as soon as possible with both determinate and indeterminate plant types. I suggest the following for Matthews Ridge at this time.

1. Choose one determinate and one indeterminate plant type from the replicated trials at Mon Repos. Choose the most productive selections unless seed of these are urgently needed for other purposes.

2. Plant large plots in rows about 80 centimeters apart (but a constant row width).

3. Establish 4 within-row hill spacings as experimental variables. Suggested spacings are 20, 40, 60, and 80 cm.

4. Plant 4 seeds per hill to insure having 2 or more plants in most hills.

5. Record data on yield and also on labor inputs. It may be that the management scheme that produces most per man hour input should be preferred over the one that produces most per acre. The wider spacings will require less time for planting and harvesting, but may require more time for hand weeding. (In this connection, reduce future weed problems by not allowing weeds to produce seed.)

6. Be sure to inoculate with Rhizobium japonicum.

7. Test planting seed to determine if planting rate should be increased, or if a seed-treatment fungicide should be used.

8. It may be better, at this stage, to use large unreplicated plots than to use small replicated plots.

9. After one season's results, evaluate carefully to determine which spacing appears best, if other variables are needed, if row width should be changed, which growth type has the most potential, etc. It is almost certain that the optimum within row spacing will be different for the two growth types.

10. Repeat the experiment with the modifications that data evaluation suggest are needed. Keep in mind that the optimum within-row spacing for a long-day season may be as much as 1½ times that for a short-day season.

Strong and weak points of selections may not be revealed fully until the selection is in field-scale production. Significant shifts in management operations may also require shifts in plant type, and conversely.

The potential for Guyana using the Chaguaramas project, Trinidad, for the production of planting seed should not be overlooked. Further purification and stabilization of varieties may also be accomplished at Chaguaramas, leaving Research Officers in Guyana more time to develop new types and to work with farmers in establishing production techniques.

Distribution:

Ministry of National Development and Agriculture/Guyana - 5 copies (Attention: Mr. Ben Carter).

Central Agricultural Station, Mon Repos - 8 copies (1 copy each sent directly to Dr. Alfred Downer, Harry Persaud, Christian Nwasike, Herman Adams, R. E. Fletcher, C. J. Muller, Neville C. McAndrew, and Nazim Kazim).

Booker Group - 5 copies (Attention: Jonathan Harlow).

Kibilibiri - 1 copy (Attention: Keith Gordon).

Ebini - 1 copy (Attention: Noel Holder).

Matthews Ridge - 3 copies (1 each to Henry Cameron, Oscar Adams, and Jerry Ifill).

AID/Guyana - 5 copies.

AID/Washington - 5 copies.

University of Illinois - 20 copies (Internal Distribution).

Mississippi State University - 2 copies (J. C. Delouche and A. H. Boyd).

TRIP REPORT

Guyana

Date Submitted: 16 December 1974

NAME: A. H. Boyd

TITLE: University of Illinois Consultant

DIV/UNIT: INTSOY (International Soybean Program) University of Illinois, Urbana, Illinois

PERIOD OF REPORT: November 12-22, 1974

ITINERARY: See attachment A

PURPOSE:

1. Make follow-up visit on previous trip covered by report dated September 2, 1974.

2. Identify problems and constraints in the areas of seed processing, drying, storage, production, and program development, and to give assistance to the Ministry of Agriculture or other interested parties.

3. Check on progress of INTSOY trials and report observations.

ORGANIZATIONS AND PERSONS CONTACTED:

1. USAID - Mr. George Eason, RDO
   Dr. Fred Marti, Agriculture Advisor

2. Ministry of Agriculture Central Equipment Station
   - Dr. Alfred V. Downer, Chief Agricultural Officer - Crops
   - Mr. Herman Adams - Plant Breeder - Soybeans
   - Mr. Christian Nwasike - Plant Breeder - Corn
   - Mr. Neville McAndrew - Seed Specialist
   - Mr. Sonny Persaud - Asst. to McAndrew

3. Bookers Group - Project Evaluation Unit
   - Mr. Jonathan Harlow - Business Analyst
   - Dr. Abdul Wahab - Crop Development Officer

RESULTS AND ACCOMPLISHMENTS

1. Visited Central Experiment Station at Mon Repos to consult with the staff on production, processing and handling soybeans for seed.

Gave advice on modifications in drying equipment and processing.

2. Gave help to the instructor of a proposed seed processing course at the National School of Agriculture by presenting pertinent slides for teaching (see attachment B) and mimeographed or offprint materials useful to the course or staff members (see attachment C).

3. Discussed production and seed problems with Bookers Project Evaluation Unit. Needed specifications and other information requested will be forwarded from U.S. Obtained interim report on their soybean project which is being forwarded toINTSOY.

4. Discussed INTSOY trials with Herman Adams and obtained data sheets on Mon Repos and Ibini from Christian Nwasike for forwarding to Dr. Hittle.

OBSERVATIONS/COMMENTS:

1. The Blairmont Estate produced 150 bushels of seed which reportedly germinated about 95%. This yield is approximately twice this consultants' estimate in August. As of 20 November, 1974 Global Agri Industries at Kibilibiri reported 1215 bushels harvested off 65 acres with a total of 114 acres on the farm. It appears that the country may have a little over 2000 bushels of seed for planting if they are moved in rapidly and processed for planting.

2. No concrete plans or timetable for planting were obtained anywhere but from Bookers Project Evaluation Unit which was 49 acres planted at Blairmont and is trying hard to get a total of 100 acres planted on various soil types. They are currently held up by non-arrival of a shipment of inoculant from the U.S.

3. At last report Global Agri-Industries had agreed to share inoculant until a resupply was obtained from the U.S.

4. The seed section at the Central Experiment Station in its function of support for the research program was engaged in shelling by hand small lots of blackeye peas, pigeon peas and corn and processing small (1 bag) lots of rice. No soybeans were being processed, but the Blairmont production had been processed the week before this consultant's arrival. Seeds were expected from Kibilibiri "next week." The seeds from Blairmont were inspected and found to contain large sticks, pods, stems, and soil peds. This indicated that the air screen cleaner was being operated with no top or scalping screen as it was observed to be set up on the previous visit. This was questioned and we were told that the new screens for the cleaner had arrived from the U.S., but they were still in a crate in the warehouse.

5. Drying was being accomplished by stacking seeds of various kinds (peanuts, soybeans, sorghum, corn) in bags in such a manner as to leave a tunnel for air from the Lister dryer to pass among the bags. Drying was accomplished but it is impossible to dry evenly or

consistently or to monitor progress with any precision with this system. We were informed that there are plans for construction of a more efficient system as soon as planting is completed. While the above described system was not as good as desired, it will work rather well if it is properly handled. The key to this or any drying operation will be careful management and operation.

6. Four new Clipper 27A air screen machines were on hand to be sent to proposed seed centers. Locations under serious consideration were Black Bush Polder, Charity, the Rupununi, and Matthews Ridge. It was recognized that drying and storage would also be necessary for the centers. We were not able to obtain any concrete plans or specifications for any of these locations even though it was expected that funding for at least two would be forthcoming in 1975. While the centers will be very rudimentary installations it will be impossible to estimate needs for funds until some plans are made.

7. Mr. McAndrew was very interested in obtaining help in his proposed course in seed processing at the National School of Agriculture. Several suggestions for laboratory exercises or demonstrations to strengthen the course were discussed with him. Slides and literature were also made available (attachment B & C).

8. Planting of INTSOY trials was in progress, previous trials had been harvested.

RECOMMENDATIONS:

1. The air screen machine at the Central Equipment Station should be set up and operated with proper screens in place when processing soybean seeds. A suggested set up for Jupiter is top 22, middle 20, bottom 11/64 x 3/4 slot.

2. A drying platform for bagged seed should be constructed for the Lister dryer as soon as possible.

3. Concrete plans and specifications should be made for drying and storage at the new seed centers. A concise statement of needs and expected costs should be prepared. This consultant was informed by Mr. McAndrew that specifications would be prepared when the funds were available but this should be made so that efficient allocation of funds can be justified. A bag dryer platform similar to a design left with Mr. McAndrew has been found to work very well. Help in calculating fan and heater sizes, etc., can be provided by request thru the USAID office to this consultant.

4. The problems that Bookers have had with coordination and operation of their soybean project only serve to solidify our previous recommendation that they should develop their own capability in seed production. For the next few years, the simplest of air-screen cleaners will suffice.

Literature and most recent available prices will be forwarded them on the Clipper M-2B, 27A and Crippen model A cleaners.

5. Price and other information will also be forwarded on planting equipment which is also essential to the success of their project.

6. It is hoped that Bookers will not become discouraged but will continue their soybean project since it appears to be the bright spot in the whole soybean development scheme at this time.

ACKNOWLEDGEMENT:

The help and courtesies of George Eason and Fred Marti are gratefully acknowledged. They were always generous with their time for advice and logistic support both of which were much needed.

DISTRIBUTION:

AID/Washington - 5 copies

Ministry of National Development and Agriculture/Guyana - 5 copies
(Attention: Ben Carter)

AID/Guyana - 5 copies

Central Agricultural Station, Mon Repos - 5 copies
(Attention: Dr. Alfred V. Downer)

Dr. A. H. Boyd

Dr. J. C. Delouche

Bookers Sugar Estates, Ltd. - Project Evaluation Unit - 5 copies
(Attention: Mr. Jonathan Harlow)

University of Illinois - 20 copies

ATTACHMENT A

ITINERARY - A.H. Boyd - November 12-21, 1974

November 12	7:40 P.M.	Arrived Timehri Airport, met by AID car and driven to hotel.
13		National holiday. Reviewed previous trip reports and worked on Trinidad report.
-	A.M.	Checked in at USAID office, discussed progress in soybean and general agricultural situation with George Eason and Fred Marti.
	P.M.	Travel to Mon Repos with George Eason to set up appointments and begin work. Had short visits with Dr. Downer, Herman Adams, Neville McAndrew and Mr. Thomas.
15	A.M.	Travel to Mon Repos to meet with Neville McAndrew and staff. Discussed his drying, processing and storage problems, also his plans for use of new equipment, storage room and two new technicians he expects to add.
	P.M.	Travel to Mon Repos to discuss plans for new course in seed processing to be taught at the school of agriculture by McAndrew. Presented set of 24 slides from personal collection for his use and suggested various laboratory exercises on demonstrations to broaden the scope of the course. Met briefly with Christian Nwasike. He has his final work on INTSOY trials almost completed.
16 & 17		Weekend. Completed Trinidad report. Prepared comments for Dr. Hittle
18	A.M.	Travel to Mon Repos. No contact with McAndrew. Checked malfunctioning moisture meter and returned to USAID office.
	P.M.	Return to Mon Repos for appointment with McAndrew but he was not in again. Returned to USAID office, began preparation of report and recommendations on work and observations to date.

19	A.M.	Work at USAID office on report to USAID and INTSOY. Attempt contact with Nwasike for further information on his INTSOY trial data.
	P.M.	Meet with Mr. Jonathan Harlow, Bookers Project Evaluation Unit.
20	A.M.	Travel to LBI Estate to meet with Dr. Abdul Wahab, Crop Development Officer for Bookers Project Evaluation Unit.
	P.M.	Travel to Mon Repos to meet with Mr. Fisher, McAndrew and Nwasike for discussion of seed program, and development plans.
21	A.M.	USAID office - Turn in interim report to Mr. Eason. Meet briefly with Dr. Wahab, and make preparation for return to U.S.
	P.M.	Depart for U.S.

ATTACHMENT B

Slides furnished the Central Experiment Station, Mon Repos for use in developing seed course at the school of agriculture:

1. Unloading system on bins at a soybean seed company.
2. Air-screen cleaner installed showing several points for better operation.
3. Disc (length) separator - closeup of disc pockets.
4. Disc separator - deagram of operation.
5. Disc separator picture.
6. Spiral separator.
7. Pneumatic separator - diagram.
8. Pneumatic separator - picture.
9. Gravity table separating soybeans.
10. Rollmill - diagram.
11. Rack of hand screens.
12. Equilibirum moisture content illustrations.
13. Title slides (6) illustrating steps and objectives of seed processing.
14. Cartoon slides (5) illustrating principles of processing.

ATTACHMENT C

Publications and printed articles furnished the Central Experiment Station, Mon Repos:

1. Differences in metabolic activity in peanut seed of different size classes - Baskin, Charles C. and Delouch, J.C. - MAFES journal No. 2192.

2. Effects of mechanical shelling on storability of peanut seed - Baskin, Charles C. and Delouch, J. C. MAFES journal No. 2194.

3. Systems for controlling relative humidity and temperature - Beck, James M.

4. How a psychrometric chart is used to determine air properties - Beck, James M.

5. Principles and methods of moisture measurement - Boyd, A. H.

6. Processamionto de semillas - Boyd, A.H.

7. Potential applications of color sorting techniques in seed technology - Boyd, A. H.

8. Harvesting handling and storage of soybeans - Delouche, J. C.

9. Maintaining soybean seed quality - Delouche, J. C.

10. Determinants of seed quality - Delouche, J. C.

11. Storage of seed in sub-tropical and tropical environments - Delouche, J. C., Matthes, R. K., Dougherty, G. M., and Boyd, A. H.

12. Seed conditioning for tropical environments - Matthes, R. K., Delouche, J. C., and Welch, G. B. - MAFES journal No. 1738.

13. Drying processing and storage of corn seed in tropical and sub-tropical regions - Matthes, R. K., Welch, G. B., Delouche, J. C., and Dougherty, G. M. MAFES journal No. 1839.

14. Electrical properties of seed associated with viability and vigor - Matthes, R. K., and Boyd, A. H. - MAFES journal No. 1703

15. Physical properties related to seed viability and vigor - Matthes, R. K., Boyd, A. H., and Delouche, J. C. - MAFES journal No. 1609.

16. Heated air drying of soybean seed - Matthes, R. K., Boyd, A. H., and Welch, G. B. - MAFES information sheet No. 1246.

17. Harvesting, source of many problems - Miller, Lee.

18. Controlled temperature and humidity storage - Munford, R. S.

19. Low cost temperature controlled rooms - Welch, G. B. and Delouche, J. C.

20. Seed processing and storage facilities for tropical environments - Welch, G. B. and Delouche, J. C.

21. Relation of moisture content, height of drop ad number of drops of soybean seed to germination. Mimeographed data sheet.

22. Drying manual - The Reed Joseph Company, Greenville, Mississippi.

Note:

All information sheets and reprints listed above were supplied by the Seed Technology Laboratory, Department of Agronomy, Mississippi State University, Mississippi State, MS 39762

Attachment D of A. H. Boyd, Guyana Trip Report
Submitted 16 December 1974

PROGRESS REPORT OF SOYBEAN FIELD TRIALS

PROJECT TITLE: Soybean Production Trials at Blairmont Estate Ltd. PROJECT NO. 58

DEPARTMENT: PROJECT EVALUATION UNIT PERIOD COVERED: April-October 1974

INSTITUTIONAL UNITS INVOLVED AND COOPERATING AGENCIES: Bookers Sugar Estates Ltd., Ministry of Agriculture, U.S.A.I.D.

PROJECT OBJECTIVES:

1. To assess the feasibility of soybean as a commercial crop.

2. To increase seeds for larger size trials due to commence in the Autumn of 1974.

Work Accomplished to Date and Present Outlook:

Bookers in collaboration with the Ministry of Agriculture, Government of Guyana and U.S.A.I.D. is producing soybeans for the first time at Blairmont Estate in the Gold Digging area.

One set of trials has been harvested and yields of 34 bushels per acre (2170 kg/ha) were obtained. Another trial consisting of about four acres is scheduled to be completed by October 31. Yields are predicted to average between 30 and 35 bushels of seeds per acre.

It is envisaged that about 100 acres of soybeans will be planted this Autumn with trials to be set up at Blairmont and at L.B.I. These trials will be aimed at assessing the growth and yield performance of sugar cane when planted on (1) fields that are flood fallowed for six months; and (2) fields from which one crop of soybeans has been harvested and which otherwise would have been placed under flood fallow.

Importance of Work in Progress to Agriculture and the Society in General:

The soybean, long known as "The Meat of the Fields" in the Orient, has become an increasingly important crop the world over; and, today it is the number one cash crop in the United States. Its high protein and oil content (ca. 40 and 20 per cent respectively on a dry weight basis) makes this crop particularly desirable for cultivation in Guyana. Indeed, the cultivation of soybean is envisaged in the Guyana development plan, and this crop is looked to for the largest contribution of all the new crops in the plan (see Draft Development Plan, chapter 14 and table 14.1).

The Guyana Government has set a target of some 15,500 acres (6,273 Hectares) for cultivation of soybeans by 1976. Since the plan was drafted, world supplies have become severely limiting and world prices have more than quadrupled (US $2.50 in 1972 to over $9.00 per bushel of 60 pounds today). At the local level, current soybean prices range from 30 to 40 cents per pound at the oil mills and when sold for seeds the seller receives a premium of an additional 10 to 15 cents per pound.

In the earlier half of this year U.S.A.I.D. in seeking to assist the Government of Guyana in its agricultural development programme requested the participation of B.S.E. in a commercial trial of soybean on the light sandy soils of the Gold Digging area at Blairmont. The viability of growing soybeans in Guyana has already been demonstrated on an experimental basis. However, its commercial viability remains to be tested.

It was then agreed that B.S.E. in cooperation with U.S.A.I.D. and the Ministry of Agriculture should conduct field trials of soybeans at Blairmont Estate to determine the commercial viability of this crop. In addition to demonstrating Bookers concern with agricultural development in Guyana and its willingness to cooperate to this end, the trials if successful, may help to introduce a useful and profitable crop to Guyanese agriculture.

Materials and Methods

Soybean seeds (*Glycine max* (L) Merr.) of Jupiter variety were used for the field trials. Jupiter is classed in maturity group IX and is adapted to Guyana's latitudinal range. When tested in Guyana floral initiation was observed 42 days following planting and crop maturity occurred at 105 days from sowing. Seeds were supplied by the Ministry of Agriculture and were taken from seed lots produced at Kibilibiri in the 1973 crop year and in the spring crop of 1974 respectively. Seeds were tested for normal germination and viability. The viability test was done using a 0.1 per cent solution of 2,3,5 - triphenyl tetrazolium chloride.

Field Studies

Land Preparation:

Three fields comprising 11.17 Rhineland acres (hectares) were converted from a pasture of Tanner grass *Bracharia* Sp. for the soybean trials. These fields constitute a part of the Gold Digging area and the soil is classified as Everton silty clay. Test plots were randomly sampled at depths of 0 to 6, 6 to 12, 12 to 18 and 18 to 24 inches. Samples were analyzed by the Central Laboratory B.S.E. for pH, exchangeable bases, phosphorous, and organic matter content. Following the pH determinations test plots were limed at the rate of two tons of limestone per acre to increase the pH of the plow layer to about 5.0. Field preparation commenced in mid-April and ended by May 5, 1974.

Following is the physical layout of the experimental site with field A lying east.

Fields	Plot Nos.	Field Designation	Measurements		Acres
A	1	A1	92.5'	601'	
	2	A2	92.5'	601'	3.68
	3	A3	92.5'	601'	
B	1	B1	100.0'	577'	
	2	B2	100.0'	577'	3.81
	3	B3	100.0'	577'	
C	1	C1	81.0'	591'	3.16
	2	C2	81.0'	591'	
	3	C3	40.5'	591'	.52
			?Total Area		11.17

To achieve a satisfactory seed bed for soybean, the following mechanical field operations were carried out:

Operations	Implements Used
Bush Clearing	Bush Rake
Bulldozing	Blade
Harrowing twice	Off Set Harrow
Sub Soiling	Sub Soilers
Shattering	Chisel Plough
Levelling	Land Plane
Rotovating	W/100/S100

Drainage

Drains were dug with a Dondi 45 on the boundaries of all three fields and connected to infield plot drains spaced at 100 ft intervals and running longitudinally. This was done to assist with draining of flood waters from the low lying areas. All these drains are connected to an outlet of sideline east of the cultivation site.

Fertilizer

A mixture of 20, 224 and 112 pounds respectively of urea, triple super phosphate and potash was applied banded with the planter at sowing.

Planting

Freshly inoculated seeds were planted with a Massey Ferguson two row planter mounted on the three point linkage of an International 574 wheel tractor. The planter was set to give a row spacing of 21 inches after two runs with the machine. Due to one-half inch holes on the seed plate which allowed two to three seeds to pass through each hole seeding rate varied from 11 to 17 seeds per foot of row. Planting commenced on May 5, and ended on May 19.

Weed Control

Planavin at the rate of 2.6 pounds in 40 gallons of water per acre was applied at planting. Following this application all other weeds were eliminated by hand as often as necessary.

Pest and Disease Control

Forthnightly applications of fungicide (Dithane) and insecticide (Aldrin and Azodrin) were made throughout the growth and development of the crop for control against leaf and pod eating insects, and possible fungal outbreak.

Results and Discussion

For clarity and convenience the results have been divided into several sections. Section one pertains to germination and its related problems, section two deals with rainfall data and soil chemical properties; and section three relates to crop growth and development and available yield data.

Table 1:- Daily Precipitation (inches) at the Soybean Trials site, Gold Digging, Blairmont Estate, from April 1 through September 30, 1974.

Date	April	May	June	July	August	Sept.
1	0.13	-	0.16	0.72	0.05	0.41
2	-	-	0.21	0.02	-	-
3	0.53	-	0.25	0.02	-	
4	2.28	-	0.95	0.51	0.48	-
5	1.42	-	4.33	-	-	0.49
6	0.13	-	0.21	0.06	0.05	1.50
7	-	0.08	0.05	0.31	0.13	-
8	-	-	0.05	0.01	0.59	0.23
9	0.08	-	0.30	-	0.39	0.13
10	-	-	-	0.22	0.10	-
11	0.09	-	-	0.06	0.03	-
12	0.14	-	-	0.13	-	-
13	0.30	0.05	-	0.49	-	-

Table 1:- Continued.

Date	April	May	June	July	August	Sept.
14	0.15	0.01	-	2.21	0.21	-
15	0.15	-	-	0.49	-	0.10
16	-	0.13	0.12	-	-	-
17	-	0.01	0.15	0.02	-	0.36
18	0.03	0.09	0.33	-	-	-
19	-	-	1.36	0.06	-	0.01
20	-	-	0.46	0.30	-	0.13
21	-	-	-	1.82	0.27	-
22	-	0.01	1.38	0.17	-	0.16
23	0.13	0.02	0.09	0.26	-	-
24	-	0.08	1.02	0.72	-	-
25	-	-	0.34	0.10	0.28	-
26	-	-	0.70	0.69	0.37	-
27	0.21	-	1.19	0.53	0.18	-
28	-	0.17	0.01	0.31	-	-
29	-	0.89	-	0.08	-	0.10
30	-	0.93	0.67	0.03	-	0.85
31		0.26		0.17	0.06	
Monthly Total	5.77	2.73	14.33	10.51	3.19	4.47

Germination

Problems Encountered

It was hoped that after planting, fields would have received enough rainfall water to enable seeds to germinate. However, this was not the case as can be seen in table 1. Test plots were then irrigated by means of a fire engine beginning May 23, but this exercise proved futile. Except for a sprinkling of plants that had come up by May 30, no stands were established. An examination of the seeds in the ground revealed that seed deterioration had taken place and that seeds might have been planted too deeply.

Replanting was started in field B on May 29 using 50 lbs of new seed material which was produced in the Spring of 1974 at Kibilibiri. This material seeded just 20 rows (0.41 Rhineland acre) in plot B2 at the original seeding rate of 11 to 17 seeds per row foot. Immediately following this planting and continuing intermittently thereafter through June 9, a total of 8.59 inches of rain had fallen on the test plots (Table 1). By this time seeds had germinated about 60 per cent in plot B2 but the other plots still lacked crop stands.

Plot C1 was replanted on June 4, with seeds of 1973 crop year, except for about 20 feet of the first two rows which was planted with 1974 seeds that had remained in the seed box after the 20 rows of Field B2 were replanted. Following this planting and continuing through 24 hours thereafter four inches of rain was recorded and fields became water logged for several days. At the end of this period the bulk of the replanted seeds had decayed. However, germination exceeded 60 per cent along the 20 feet of the first two rows that had been planted with seeds of the 1974 spring crop. One plausible reason for this is that the 1974 seeds were slightly more vigorous and were more highly germinable than the 1973 crop seeds (Table 2). Also indicative of these results is that both seed lots performed poorly when compared to the requirements for certified planting material (at least 85 per cent normal germination). This was confirmed by results of a stress test conducted at Mon Repos on these seeds. Under adverse germination conditions the 1973 and 1974 seeds germinated 30 and 60 per cent respectively.

Table 2: Germination and Viability Results of Soybean seeds obtained from Mon Repos and planted in Trials at Blairmont Estate.

Crop Year	% Normal Germination	% Viability*
1973	71	74
1974	76	76

*Viability was determined by the Tetrazolium test.

Due to an inadequate supply of 1974 crop seeds only Field A was replanted. This was done between June 13 and 15. Just prior to planting inoculated seeds were treated with fungicide (Dithane - M45) at the rate of one pound per 200 pounds of seed. To ensure acceptable crop stands seeding was done at two times the previous seeding rate. Field observations made on June 21 or about one week after planting revealed that except for low lying areas that had been flooded for several days, germination and early seeding growth was satisfactory.

Rainfall Data and Soil Properties

The rainfall data for the months of April through September, 1974, are presented in Table 1. A total of 41 inches of rain fell during this six month period. Plants in Field B2 received 33.63 inches of rainfall water from sowing to harvest. There were no periods of sustained dryness and rainfall occurred at times to coincide with high crop water requirements such as during germination, the period preceeding flowering, pod set and seed filling. Field A1, A2 and A3 received 26.00 inches of rainfall water from sowing through the seed filling stage. During the latter part of May and the first week of June heavy rains caused localized flooding in these fields which resulted in poor plant stands in these flooded areas. Subsequent to this, rainfall was well distributed to coincide to periods of maximum water use by the crop.

The chemical properties of the soil are presented in Table 3. It was originally proposed and decided to conduct the trials on the light sandy soils of the Gold Digging area. However, the drainage system of this area was found to

be unsatisfactory for soybean cultivation. It was then decided to shift the trials to a more free draining area. The present field site was then selected but the soil here is comprised of silty clays rather than sands. The term Everton silty clay is used on the Blairmont Estate to identify the soil of this area. As shown in Table 3, the soil reaction is highly acidic within the 0 to 12 inch soil layer. Magnesium levels are adequate for crop growth. Calcium, phosphorus and potassium levels are low but this was partially corrected by the application of these nutrients at sowing. Total soluble salts within the upper 12 inches of the soil profile are within the tolerance range of most crops. However, the organic matter content corresponding to this soil layer is low.

Table 3:- Some chemical properties of test soils (Everton silty clay) from soybean trial plots at Gold Digging, Blairmont Estate.

Soil depth (inches)	pH 1:2.5	Total Salts ppm	Meq/100 g Ca	Mg	K	ppm p (Truog)	% C
0 to 6	4.50	534	3.83	10.71	0.59	4	2.20
6 to 12	4.60	877	1.70	11.55	0.32	4	1.07
12 to 18	4.75	1367	1.39	9.12	0.33	3	-
18 to 24	5.45	1563	1.70	8.80	0.32	4	

Crop Growth and Development and Yield Data

Field B2

Good crop stands were obtained in field B2 consisting of 20 rows which were resown on May 29 with 1974 crop seeds. Nodulation had commenced within four weeks of planting and floral initiation was observed on some plants 46 days after seeds were planted. At this time plants were 20 to 36 inches tall. During growth undesirable plants of other soybean cultivars and of crops other than soybeans notably corn and blackeye were rogued. Roguing was 100 per cent effective against other crop plants but other soybean cultivars persisted through harvest. On September 18, moisture determinations indicated that harvesting should be done the following week or 120 days following planting. A custom built thresher (Bill's welding shop, Pullman, Washington, U.S.A.) was obtained from Mon Repos and transported to the trial sites for the harvesting operation.

Harvesting and threshing commenced on September 24. Plants were threshed, following harvest by hand. While some plants threshed easily, others resisted depodding. Closer observations revealed that the seeds of these plants had commenced germination within the pods. A detailed check within the field plot revealed that about 37 per cent of the plants exhibited vivipary. These plants were taller and seeds were elongated and larger than those of the Jupiter variety. Moisture determinations of seeds sampled on the morning of harvest indicated that seeds of the Jupiter variety contained 15 per cent moisture while seeds germinating within pods gave 127 per cent moisture.

Due to lack of varietal purity and uneven maturity between plants, harvesting was stopped at which time an area consisting of 0.12141 hectare (0.302 English acre) had already been cleared of plants. Threshing was completed on all of the dry pods and the remaining plants were transported to Ogle and dried at 90° to 98° F for 16 hours. Following this, plants were threshed, seeds were "winded" to remove pods and straw that fell into the bag along with seeds, and seed material was dried in the sun for two days. Twenty samples were tested for moisture content following sun-drying and these determinations gave a mean moisture of 4.87 per cent. Seeds were then weighed and bagged. The total yield of seeds obtained from the harvested area is shown in Table 4.

Table 4:- Yield data of Soybeans harvested from field B2.

Area harvested		Weight of seeds at 12% moisture content		Yield expressed in		
Acre	Hectare	Pounds	Kg	Bu/acre	lb/acre	Kg/ha
0.302	0.121	580	263	34.3	1921	2.170

It is estimated that about five per cent of the total yield was lost during the harvesting, threshing, drying and bagging operations. When the net seed weight is adjusted for this loss a total yield of 36 bushels per acre (2.28 metric tons per hectare) is realized. This yield compares favourably with those obtained in Guyana on much smaller experimental plots. At the current world price of soybeans ($9.00 US/bu.) this yield will realize a gross income of $324.00 U.S. per acre-per crop or $648.00 U.S. per acre per year.

Fields A1, A2 and A3

These fields constitute a total area of 3.81 acres or 1.54 hectare. Plants flowered 40 days after planting and, pod set was good. Harvesting is planned to begin on or around October 23. Except for a few low lying areas within the plots, excellent crop stands were established and a yield of 30-35 bushels is predicted providing good weather conditions prevail at harvest time.

Field C

Due to excessive moisture following planting, the bulk of the seeds decayed and this field was subsequently abandoned. However, the sprinkling of plants that survived went on to pod heavily. This was apparently due to less plant competition and greater availability of plant nutrients relative to Fields A and B. These plants will be harvested for seeds, but no yield data will be taken.

Future Work Plans

It is envisaged that about 100 acres of soybeans will be planted this Autumn using the seed yields of plots A1, A2 and A3. Planting will be done again at the Gold Digging site, utilizing the entire 11 acres; and, other plantings will be done at Haly Polder, Blairmont Estate, and on fields yet to be identified at

L.B.I. Estate.

These trials are aimed at, comparing the performance of cane planted after fields have been flood fallowed for six months (Control) and after a soybean crop has been grown and harvested from fields lying adjacent to those to be flood fallowed. It is hypothesized that following a soybean crop, the nitrogen status of the soil will have increased to the extent that adequate amounts of this plant nutrient will be present for the ensuing cane crop. Should this claim be substantiated it may prove economically worth while for B.S.E. to produce soybeans on fields that will otherwise have been placed under flood fallow, and at the same time realize some of the soil ameliorating conditions that this practice accomplishes.

ACKNOWLEDGEMENTS

The Project Evaluation Unit (P.E.U.), Booker Group, wishes to express its sincere appreciation to U.S.A.I.D. and the Ministry of Agriculture, Government of Guyana for having collaborated in the planning and execution of these trials.

For giving so much of their time and physical facilities throughout the course of these trials, P.E.U. is greatly indebted to everyone at Blairmont Estate, who was involved in one way or another.

Special thanks is extended to the fine group at Agricultural Machinery Service, B.S.E., for their excellent work in land preparation; and to the staff at the Ogle Workshop for their valuable assistance in drying and bagging.

TRIP REPORT - GUYANA

Date Submitted: May, 1975

NAME: Lloyd R. Frederick

TITLE: Professor of Soil Microbiology

DIV/UNIT: INTSOY (International Soybean Program)
Department of Agronomy, University of Illinois
Urbana, Illinois 61801

PERIOD OF TRAVEL: (Inclusive Dates): 24 February 1975 to 8 March 1975

ITINERARY: Ar Georgetown, Guyana 23:00, 24 Feb 1975. Lv Georgetown, Guyana, 10:20, 8 Mar 75. Attachment A includes details of itinerary with schedules.

PURPOSE:

1. To advise and consult with Mr. Harri Persaud concerning legume inoculation, preparation of inoculants, and inoculation experiments.

2. To take to Guyana some strains of soybean, cowpea and peanut rhizobia and samples of inoculants, including granular and pelleted materials.

3. To visit organizations and personnel concerned with production of soybeans.

4. To observe soybeans at available locations, observe nodulation, and discuss possible solutions to production problems.

5. To present seminar on legume inoculation.

6. To discuss microbiology course.

7. To suggest additional information and materials that may be useful for soybean production and utilization.

ORGANIZATIONS AND PERSONS CONTACTED:

Agricultural officers with the Ministry of Agriculture, the Central Experiment Station (Mon Repos), the Ebini Research Station, Agri-Industries at Kibilibiri, and some personnel at Kairuni Expt. Sta and some private organizations, especially Bookers Sugar Estates. See Attachment B for detailed listing.

RESULTS/ACCOMPLISHMENTS:

1. Transported and delivered several strains of soybean rhizobia from Dr. Deane Weber, USDA - Beltsville, Maryland; several strains of soybean, cowpea and peanut rhizobia, several packets of regular inoculants, and about 5 lb. of pelleted inoculant for soybeans from Dr. Forster Davidson, Research Seeds, St. Joseph, Missouri; and 5 lb. of peanut SOIL IMPLANT granular inoculant and 3 lb. of soybean SOIL IMPLANT inoculant from Dr. Joe C. Burton, Nitragin Company, Milwaukee, Wisconsin.

2. Visited soybean plots at Mon Repos (Mr. Adams and Mr. Fletcher), Enmore (Dr. Wahab - Bookers Sugar Estates) and Ebini (Mr. Adams and Mr. Fletcher) and Kibilibiri (Mr. Fletcher and Mr. Gordon).

3. Visited peat formation in the field.

4. Visited greenhouse used for plant growth tests. Discussed problems of light and environmental controls, especially dust and contamination from other activities. Noted that machinery was already available, (if it can be borrowed from other projects, such as ant bait manufacture) for experimental batbhes of pelleted inoculant.

5. Presented seminar on legume inoculation, stressing (a) importance of host plant susceptibility and specificity (b) importance of high populations of rhizobia at inoculation. One method of getting higher rhizobial populations is to place the inoculant in the soil at time of planting instead of on the seed. High populations (millions rhizobia per seed) have resulted in earlier, tap root nodulation, (may be of great importance in determinant varieties), more rapid early growth and N_2 fixation, nodulation in the presence of considerable nitrate, and fewer nodulation failures due to adverse conditions such as hot, dry, or acid soils.

6. Suggested field experiments on inoculation methods with varying numbers of rhizobia (similar to experiments described in Weaver's Thesis (copy left with Mr. Persaud).

7. Noted limitations on photosynthetic capability during the shorter day season.

FOLLOW-UP ACTION REQUIRED AND RECOMMENDATIONS:

1. Guyana has the necessary resources to manufacture inoculants. The unique resource available is the presence of extensive peat deposits. Inoculants for forage and grain legumes grown in the tropics can be produced. A determination of the needs and potential market would be valuable in planning the scale of manufacture.

2. Mr. Harri Persaud is a capable microbiologist and would benefit greatly from (1) visits to inoculant manufacturers, (2) attendance at meetings with other scientists working with rhizobia and (3) visits to other laboratories where rhizobial studies are being conducted.

3. Additional equipment is needed for microbiological work. Some of this is currently under consideration. For example, a laminar flow hood to provide aseptic working conditions would be very valuable. Adequate autoclave facilities are needed, as are additional cold storage and freezer capacity. For serological work, a temperature-controlled water bath is needed and for more sophisticated serological work, a fluorescent microscope would be needed. A gas chromatograph with acetylene and ethylene sensing capabilities would aid greatly in detecting nitrogen fixation capability.

4. Proper nodulation of inoculated soybeans was often noted in the field, but studies on use of larger numbers of rhizobia, possibly with granular or pelleted peat materials, are suggested.

5. Inoculation is essential to insure nitrogen fixation capacity, but the actual fixation is dependent on the photosynthetic capability of the soybean or other legume. In other words, inoculation benefits are dependent on high production by the plants. Some suggestions are in Attachment C.

6. We very much appreciated the friendly hospitality, the courtesies and cooperation extended by all of the people we met. Guyana is a country with considerable potential. We would like to return.

ATTACHMENT A - GUYANA

DETAILED ITINERARY AND SCHEDULE OF ACTIVITIES

Mon 24 February 1975

Lv Port of Spain, Trinidad 21:00 and Ar Timehri Airport, Guyana 23:00. By taxi to Park Hotel, Georgetown, Guyana arriving somewhat after 24:00.

Tue 25 February 1975

A.M. Met with Dr. Fred Marti at USAID office. Also met Ashton Veramallay and Dr. James Prescott (working on economics of drainage improvements) of Iowa State. Prodeeded to Mon Repos Central Agricultural Experiment Station, where we met Dr. A. V. Downer, Herman Adams and Harri Persaud. Made plans to return to work with Mr. Persaud the next day, drove to LBI where we met Dr. Abdul Wahab, who is in charge of the field work for the PEU Unit of Bookers Sugar Estates, Ltd. Made plans to see their soybean work and discussed successes and problems they have encountered.

P.M. Stopped at Bookers and met Dr. Nelroy Jackson and John Bates. Met with Ben Carter, Chief Agricultural Officer, at the Ministry of Agriculture, to discuss the soybean project and plants. Apparently, progress in developing soybean acreage has been very slow. Adams, Persaud, Marti, Veramallay, Prescott, and Frederick (and wife) were present for a brief discussion. Marti and Carter agreed to send the 100 lb. peat to Dr. Davidson as soon as possible.

Eve. Visited with Abdul and and Danielle Wahab (hosts), Mr. & Mrs. Fredericks of Shell, and Jonathan Harlow of Bookers. One major advantage for soybeans is the low predial loss. Bookers are interested in soybeans to replace flood fallow in sugar cane rotation.

Wed 26 February 1975

A.M. Met with Harri Persaud and learned of his progress. He has received some equipment and was evaluating field inoculation trials on peantus. Nodulation appeared good. Need a laminar air flow cabinet to minimize contamination. Has found some strains that are better nodulators for soybeans, black-eyed peas (Vigna sinensis), peanuts, Phaseolus and pasture legumes. Evaluations are made by yield (dry matter), nodule number, nodule location, nodule color (red considered active) and total N by Kjeldahl on some samples. Some correlation between yield and abundant nodulation in the tap root zone. Relationships to grain yields was not so clear and needs further work. Has isolated rhizobia from various locations, including the savannas. Characterized isolates by growth on different sugars, at different temperatures. Stock cultures are evaluated in the greenhouse and then in the field. Has found that rhizobia survived only about 3 months in a peat sample that included the top 12 inches (analyses indicate possible Al toxicity in the surface layers). Discussed field plot designs. Gave him the cultures from Dr. Weber and Dr. Davidson and the samples of inoculum and seed treatment (Moly-Soy-Alive thiram plus molybdenum and other nutrients). Persaud wanted to know how these new cultures related to those he had previously received. (Dr. Deane Weber should be encouraged to bring such information together as much as possible. We need a World Center for Rhizobia.) It is expected that these samples will be shared with Bookers and other growers needing inoculum.

P.M. Visited breeding plots at Mon Repos with Herman Adams' assistant. Much difficulty had been experienced in getting a stand during the planting season for this short day season. Jupiter and Jupiter crosses were the best

looking soybeans. Getting a good stand and weed control were major problems. Some of the plants were less than a foot tall, although the Jupiter and a few other selections were 2 to 3 feet tall. Seed production will be very low. Some varietal mixture appeared to be present and was being rogued out.

Eve. Were guests of Mr. and Mrs. Mohamed Zwan. Visited with Veramallay, Jim Prescott, Mr. and Mrs. Shearer (he is with Chase-Manhattan Bank), and our hosts - (he is owner of about 600 A. rice land, and also a shirt distributor). Discussed agricultural economic situation.

Thurs 27 Feb 1975

A.M. Traveled inland to McKenzie to see the interior (white and brown sands). Visited the Guyana Bauxite Mines (Guybau) at Linden with Mr. and Zwan (our hosts), Veramallay and Prescott with a group from Georgetown and Ottawa, Canada (Twinning Groups). At lunch, one of the Georgetown ladies asked how she could get information about cooking soybeans. Referred her to Dr. Marti.

P.M. Stopped at Kairuni Expt. Station on the brown sands. Mr. Cook had the 36 acre experimental farm in excellent condition. The husbandry was superb. No soybean trials were in progress during this season. Black-eyed peas and peanuts were being grown between the tree crops and looked vigorous. Nutrient deficiencies were very apparent on the corn trials. On the legumes, less deficiency symptoms were present but some remarkable responses were noted to phosphorus and other treatments that were not labeled. The inoculation trials on peanuts showed no noticable differences in growth or color as all peanuts appeared dark green and vigorous.

Fri 28 February 1975

A.M. Spent most of the morning with Fred Marti getting my visa extended. Harri Persaud came in and we planned a visit to Ebini for Wednesday, if possible. Mr. Bernard Yankey of the Caribbean Development Bank came to the U.S.A.I.D. office and we visited with him. He is working on a $2 million loan to the GOG to develop soybean production. It was pointed out that soybeans had been grown successfully but that there were many problems wtih weather, seed quality, weeds, etc. that have been encountered.

P.M. Accompanied Harri Persaud to Mon Repos. Went to field plots for seed increase under Roland Fletcher's supervision. The plants were light green. We examined some plants for nodules. The nodules were few but large and very red indicating few rhizobia present when plant developed. Some factor other than N might be responsible for the poor growth and yellowish color. Genetic seed material is so valuable that economic factors should not limit increase of basic quantities. We discussed the possibility of small plots where fertility, inoculation and other management practices were used at maximum level to maintain seed stocks and determine the actual yield potential. The practical economic level could be determined with further experiments by lowering different inputs, eliminating those with least effect on yield. Perhaps some INTSOY trials should be planted in both the long season and the short season. It may be discovered that different varieties should be used in the two seasons. Seed quality appears to be a major production block in the wet clay lands in the Georgetown area. Adequate inoculation is needed, but is of little value unless good soybean growth is obtained.

Eve. Visited the new home of Dr. and Mrs. Nelroy Jackson (fertilizer and chemicals for sugar production for Bookers group).

Sat. 1 March 1975

Worked on Trinidad and Guyana reports.

Eve. Dinner with Dr. and Mrs. Nelroy Jackson and Hans Hanson of Bookers.

Sun. 2 March 1975

Visited rice farm (600 A) with Mr. and Mrs. Zwan on Mahaicony River (Creek).

Mon 3 March 1975

Spent entire day with Harri Persaud. Discussed microbiology course taught here. Some items needed by Harri included: glass beads for storing rhizobia; information on soybean, rhizobium and agronomy meetings in U.S.A., and inoculant manufacturers to visit; Dr. Burton's manual on rhizobia and his chapter from Peppler's "Microbial Technology"; what chemical methods to use in soil testing (SOIL TEST, N. Carolina?); information on Hallsworth's Nutrition of Legumes and other books; information on push planter and cone planters. Discussed growing legumes - why soybeans are so short during this "winter" season? - need for strong emergence characteristics, better husbandry. Suggested that a small area be used to "shoot the moon" with soybeans to determine maximum production potential. Eliminate fertility as a limiting factor, provide excellent drainage, etc. Perhaps on an acre basis, 600 lb. P_2O_5, 300 lb. K_2O, 100 lb. S, 100 lb. Ca and 50 lb. Mg with trace elements added by including in fertilizer or by spraying. If pesticides need to be sprayed on, micronutrients can be efficiently added at the same time. Perhaps all nutrients could be sprayed on to avoid soil fixation. Ground aragonite is $100/T; shell (unground) is $35/T.

Economic considerations: black-eyed peas (Vigna sinensis) currently bring $0.50 to $1.00 per lb to the farmer. Reasonable yield is 800 to 1000 lb/A. What price would be needed to encourage farmers to try soybeans - $1.00 to $1.50/lb? (World market soybeans are less than 20¢/lb).

Discussed inoculum production. Rhizobial strains are being evaluated in greenhouse (in pots) and in field. Suggested layer of coarse gravel on surface of pots to reduce air contamination. Greenhouse is dusty because other activities are going on, such as bagging cushi ant bait. Need greenhouse facilities that are as clean and free of dust as possible for strain evaluation and rhizobial population studies. If available, machinery used for ant bait could be used for peat grinding and pelleting of inoculants, also a bag sealing device is available.

Eve. After dinner, drove with Zwans to see Georgetown at night. Discussed farming, economics, on roof garden of Kwong Ho's restaurant.

Tue 4 March 1975

Traveled with Dr. Marti (A.I.D.) to L.B.I. (La Bonne Intention) Ranch. Visited Sugar Cane Expt. Station, had brief visit with the director, V. M. Young-Kong. Smut is a major problem in cane. Soybeans do not seem to have any parasites in common with sugar cane. Near the building Dr. Abdul Wahab (P.E.U. unit of Bookers) had some small outdoor sand trials of legumes. The Jupiter soybeans were 2 1/2 to 3 feet tall, lush growth and setting pods. Apparently the short plants in the field are due to factors other than day length, although these were planted in January. Inoculated plants had excellent nodulation. Uninoculated plants had few, if any, nodules but had had adequate N fertilizer.

Proceeded to Enmore Estate. Saw 4 fields of soybeans, all of which were very short - most plants under 12" tall. Stands varied from very poor to fair on November plantings. January planted (hand) plots had fairly good stands but were still short, and had very poor nodulation? Is shortness due to nutrient deficiency (P?) or to poor "physical" condition of soil? These fields were planted on cambered beds in rows 18-20" apart with about 5% slope between drains making machine harvest difficult. Some stand loss due to erosion and poor drainage was noted. Weed control with preemergence Planavin was fair. Some girdling of some January planted beans was noted. Major feature was lack of photosynthetic leaf area. Can this be corrected with proper variety or proper management? More research is indicated.

The group included Dr. Fred Marti, Dr. Ed Torre (U.S. Embassy), Jonathan Harlow, Dr. Abdul Wahab, Leslie Simpson and Harri Persaud (Mon Repos) and Al Vestrich (acting director U.S.A.I.D. in Guyana).

The afternoon was spent looking over the field in detail, noting soil variability (sandy areas were ripening (Nov. planting))and discussing posibilities such as ridge and furrow irrigation. Ridge planting experiments are strongly recommended - also cultivation to reduce weeds and improve soil surface structure. Fertilizer trials should be included to determine potential. Some soybeans were found in a small garden plot near the sugar mill that were about 2 to 2 1/2 feet tall and well podded, with excellent stand, indicating the larger fields may be lacking in fertility.

Visited a portion of the peat formation. This area is being considered for development. Drainage would be essential, bur drainage and cultivation would also accelerate decomposition and result in rapid loss of the peat. This peat may be of use for special uses, such as a carrier for rhizobia or as a gardening material. For such uses, the peat deposit would be removed, dried and ground. For inoculant production, the survival of rhizobia should be determined. Another important criterion of its value for rhizobia inoculant production is its ability to allow an increase in numbers of rhizobia during the aging step after rhizobia, peat, charcoal and lime are mixed together.

Eve. Dinner at the home of Dr. and Mrs. Marti. Guests included Dr. and Mrs. Abdul Wahab, Mr. and Mrs. Herman Adams, Mr. and Mrs. Roland Fletcher, Mr. and Mrs. Jonathan Harlow, Mr. and Mrs. Harri Persaud and Mr. and Mrs. Leslie Simpson. A lively discussion including potential of soybeans followed.

Wed 5 March 1975

To Mon Repos. Talked with Harri about inoculant production and quality control of inoculants. Showed him slides and discussed equipment used in inoculant production and need for evaluating rhizobial numbers in inoculant and in application of inoculants in the field. Briefly mentioned delivery systems to get inoculant applied. Concluded that peat-based carriers are probably the most useful system with the present farming enterprises, although soil incorporated inoculants can be applied either as granular material or as liquid.

A trip to the U.S. for Harri Persaud to see inoculant production, to learn about serological techniques and to attend international meetings and meet other workers with rhizobia was discussed. (Louisiana cane and rice lands are more like Guyanese soils near Mon Repos, and Florida sands have some characteristics similar to Guyanese sands.) Tentatively, the following itinerary was proposed:

Visit U.S.W. Louisiana - rice and sugar cane and soybeans - Lafayette, Louisiana. (Alternate - Texas A & M, Dr. R. W. Weaver peanuts and soybeans on clay?)	8 days
Visit Arkansas rice and soybeans	1 or 2 days
Visit Research Seeds, Inc. (inoculant manufacturing) 310 S. 3rd Street, St. Joseph, Missouri (Dr. A. A. Hendrickson, Dr. Forster Davidson)	3 days
Visit U. Minnesota - (serology and agronomic work in soybeans) Dr. George Ham and E. L. Schmidt	2 days
Visit Nitragin Company (inoculant manufacturing) (strain testing) 3101 W. Custer Avenue, Milwaukee, Wisconsin. (Dr. Joe C. Burton)	2 or 3 days
Attend World Soybean Conference, U. of Illinois, Urbana, Illinois	5 days
Visit Soybean Investigation U.S.L.A., Beltsville, Maryland U.S.D.A.-ARS, Dr. Deane Weber	3 days
Attend N. American Rhizobium Conference, Raleigh, North Carolina (Dr. Gerald Elkan)	4 days
Visit Florida Ag. Exp. Sta. - soybeans and peanuts on sand - Gainesville, Florida (Dr. Dave Hubbell)	3 days
Attend Am. Soc. Agron. Meeting - Knoxville, Tenn.	5 days

Approximately 40 days @ U.S. $30/day per diem plus Air Travel (about $1000)

After lunch, I presented a seminar on legume inoculation and emphasized rhizobia specificity, host genetics in accepting nodule formation, the increase in growth, early nodulation and competitiveness with soil strains that resulted from using inoculation rates supplying millions of rhizobia per seed in our tests, but such data are needed for Guyanian conditions.

Suggested tests on soil incorporated inoculum in Guyana especially since the seed should be coated with fungicide and insecticide (and perhaps micronutrients). About 35 persons attended, including representatives from the Ministry of Agriculture (including Mr. Chesney), the Agriculture School, the Bookers Group, as well as staff from Mon Repos. Mr. Chesney said the Ministry of Agriculture would send a plane to Ebini tomorrow so Dr. Marti made arrangements on our way home.

Eve. Dinner with M. J. Zwan's and Persaud's. Good conversation.

Thurs 6 March 1975

Left Ogle airport in Henry Fitt's plane with Harri Persaud, Roland Fletcher, Herman Adams and Miss Stevenson, and proceeded to Ebini Experiment Station in the savannah area. This station is primarily a cattle (and some sheep) station with good pastures and the best-looking cattle I'd seen in Guyana. Santa Gertrudis breeding was evident; was told that Brahman breeding was also being used. Met the crops men, especially E. Munroe, and looked at the soybean seed increase field (very poor stand, growth and nodulation). No micronutrient fertilizer had been used. The black-eyed peas were good in some fields and poor in others due to variable seed quality. Peanuts were also variable - one field had little or no nodulation, another following styloxanthes had good nodulation. Inoculum, when used, appeared to be fairly good, although several instances suggesting that higher numbers of rhizobia could be beneficial were noted. Variety trials looked better; a cross with some indeterminate characteristics appeared to have more photosynthetic capability due to greater height. Fertilizer and inoculum rates used were higher than normal. Seed increase fields are so valuable that abundant fertilizer, lime, etc., should be applied. Pastures looked good and legumes were noted.

Discussed with Roland Fletcher and Harri Persaud the idea that, in these tropical soils, fertility studies should depart radically from the customary temperate zone studies. To determine production potential, a complete fertilization program (assuming no nutrients available from the soil) should be used as a control. It was recognized that this level may not be economic, but then certain treatments would be removed or scaled downward to determine yield relationships. Economic relationships could then be determined. Other treatments could be measured against the "full treatment" much like we can evaluate rhizobial strains by measuring against a "complete nitrogen" control.

After a delicious lunch, we flew to Kibilibiri and visited Global Agriindustries with Mr. Keith Gordon. The best large field of soybeans we have seen was growing here, although other fields were weed (grass) infested and very poor. Better grass control is imperative for good production. Cowpeas looked very good also. Looked at planting machinery. Harri hopes to get a pesticide applicator to test with his granular or pelleted inoculant materials for application.

Eve. Dinner at the home of Persaud's, Mr. and Mrs. Adams, Mr. and Mrs. Fletcher and Mr. Chesney were also guests. Good conversation; some discussion of Ebini-Kibilibiri trip.

Fri 7 March 1975

Dr. Marti, Harri Persaud and I met with Mr. H. A. D. Chesney, acting-chief agricultural officer of the Ministry of Agriculture. Reviewed briefly visit to Ebini and Kibilibiri. Favored suggestion that inoculant production be undertaken in Guyana to provide inoculants for grain and forage legumes here, and possibly in nearby countries. Recommended that Harri Persaud and others, maybe two, attend the World Soybean Conference, with Harri to also visit inoculant manufacturing and laboratories to increase his knowledge of techniques. Returned to hotel.

Continued discussion of problems in soybean production with Harri. Checked list of items he needed. Received call from Carl Hittle, checked with Fred Marti, and got encouragement to extend task order. The Guyana Ministry people also appear to want to continue the relationship. Began preparations to leave.

Eve. Dinner at the home of the Wahabs; Mr. and Mrs. Roy Wilkens (Bookers) were also guests. Discussed agricultural development in Guyana. Most notably, they have found Brachiaria sp. (grass) to be excellent pasture. Have been fertilizing with 2 cwt. nitrogen but plan trials without nitrogen. One cow/A can not keep it down. He has been corresponding with Peter Dart at Rothamsted.

Fri 8 March 1975

Left Guyana with wonderful send-off from Zwans and Persauds. We left with a deep sense of gratitude for the cooperation and hospitality we enjoyed in Guyana. People at Mon Repos, the Ministry of Agriculture, Bookers, at the outlying experiment stations and at the U.S.A.I.D. Mission were most helpful. We hope that we might have been of some help to those interested in soybeans. We were impressed with the ability and interest in learning how to produce agricultural crops. Some of the problems are immense but these people can overcome them. We hope to be able to return some day.

ATTACHMENT B - GUYANA

ORGANIZATIONS AND PERSONS CONTACTED

Ministry of National Development and Agriculture

Ben W. Carter, Chief Agricultural Officer
H. A. D. Chesney, Deputy Chief Agricultural Officer
John Browman, Principal Agr. Officer, Extension
Ashton Veramallay, Hydraulics Division, Economics

Central Agricultural Station, Mon Repos

Alfred V. Downer, Principal Agricultural Officer
Harri Persaud, Microbiologist
Roland Fletcher
Herman Adams
several others

Bookers Sugar Estates, Ltd.

Roy Wilkens, Project Evaluation Unit
Abdul Wahab, Project Evaluation Unit
Jonathan Harlow, Project Evaluation Unit
Leslie Simpson
Nelroy Jackson
John Bates
Hans Hanson
several others at Blairmont and Enmoor Estates

Ebini Research Station - brown sands - savannah

Noel Holder, Livestock Officer and Director
Earl Munroe
Clive Fraser

Kairuni Research Station - brown sands - forest

Mr. Cook, farm supervisor

Kibilibiri - Global Agricultural Industries, Ltd.

Keith Gordon

U.S.A.I.D. Mission, Guyana

A. I. Vestrich, Acting Director
Fred Marti, Agr. Economist
several others

U.S. Embassy, Guyana

Fred Torre, Economist

Other

Bernard Yankey, Projects Officer, Caribbean Development Bank, Barbados
Gene Chaikin, Peoples Temple Agr. Mission. Port Kitume Agr. Proj. (Matthews Ridge)

Stephen Naraine, Supt. Machinery - Bookers
Mr./Mrs.Fredericks, Shell Chemical, Georgetown, Guyana
Mr./Mrs.Shearer, Chase-Manhattan Bank, Georgetown, Guyana
Ned Coe, Agr. Engineer, TAMS

ATTACHMENT C - GUYANA REPORT
Production Potential of Soybeans in Guyana

Because nitrogen fixation by soybeans is determined by the production capabilities of the crop, we are interested in finding ways to improve production. Once the production capability and ways to achieve consistent production have been determined, the economic optimum can be determined. Because my visit was brief and my knowledge of Guyana is meager, some of the knowledge that could be obtained from these trials may already be available. Our primary concern here is to produce adequate consistent yields. Seed quality, harvesting, storage and processing problems are very important (and may block further development or make soybeans unfeasible), but these remain academic unless dependable production is achieved (unless beans are imported).

It has been shown, in isolated instances, that soybeans can be grown and can produce reasonably well (at least 2400 lb/A). Further studies are needed to learn how to get consistent economic yields. The following suggestions are based on reports from other consultants from INTSOY, reports and ideas from the people working with the Ministry of Agriculture and the PEU group of Bookers, and my experience.

A. <u>Seed selection and planting design</u>:

1. Seed selection: Obtain the highest quality seed available of the best varieties. Continuing research is needed to obtain varieties able to maximize photosynthetic capability. Varieties should also be receptive to nodulation and nitrogen fixation by rhizobia. Jupiter seems to be most promising, although its short-day season performance seems disappointing. Dr. Paschal (with INTSOY at Mayaguez, Puerto Rico) has another variety from Taiwan that looks promising.

2. Planting design:

   a) Time of planting: What is the yield potential for soybeans planted in each month of the year? Should short-day season planting be delayed until January?

   b) Row width and plant spacing should maximize photosynthetic capability, but pests must also be controlled and spacing must allow good husbandry. Short plants need to be in narrow rows. Taller plants may be in wider rows. But machinery, cultivation, irrigation, drainage and harvesting methods must also be considered.

B. <u>Planting</u>:

1. Tillage and seed bed: The soil should be worked to provide a good seed bed. When the soil is moist, the seed should be planted. Plant seed in moist soil; on soils without crusting problems, seeds can emerge from 3" (or more). If dry, the soil should be moistened by irrigation or rain before final tillage and planting. Good drainage is very important. Soybeans are not tolerant of flooding. The seed should be planted when the soil is in good condition regardless of exact date (or holidays!). In soils where crusting is a problem, planting rate should be increased experimentally to determine the seeding rate necessary to get good stands.

Perhaps 2 seeds per inch may be needed. Seedling vigor should be a characteristic of the desirable varieties. On soils subject to flooding, try planting soybeans on small ridges high enough to keep seeds out of flood water.

2. Seed protection: Seeds should be treated with fungicide and insecticide, probably with slurry-type treatment. Would a systemic like benomyl (Benlate) be more effective than Thiram (Arasan) or Captan? An insecticide like Carbofuran (Furadan) could be tried. Molybdenum and some other micronutrients might also be put on the seed as long as these materials do not damage the seed germination or seedling vigor.

3. Inoculation: Adequate inoculation is necessary to insure that nitrogen fixation will meet the crop needs. Trials with liquid or granular inoculant in the row at time of planting should be valuable. Inoculants must contain active strains of rhizobia selected to fix nitrogen well with the soybean variety.

4. Weed Control: A good herbicide should be used preplant or pre-emerge. Trifluralin (Treflan) has been very good for controlling grasses but must be incorporated by mixing into the soils immediately after application. Weed control is essential. Cultivation by machine or by hand can also be successful if carefully and persistently done. Soybeans need excellent husbandry!

C. Fertility

1. No plant can get nutrients from a soil containing no nutrient, but some crops can use less available forms. Soybeans require sizable amounts of nutrients, and have much higher amounts of elements like K, N, etc. per pound of grain than crops such as corn. Be sure enough nutrients are present to meet the need of the crop yield desired.

2. In production fields, supply adequate nutrients to obtain most economic seed yields. Without nutrients, photosynthetic ability is limited and, since N_2 fixation is dependent on photosynthetic product, N_2 fixation, protein production and yield are limited.

3. Small plots should be heavily fertilized with all known required nutrients to determine growth potential.

4. Efficiency of nutrient uptake is affected by fixation by the soil. Application of nutrients should be done carefully to minimize fixation. What is the effect of band application? foliar application?

D. Cultivation:

Most successful soybean producer cultivate their soybeans at least once during the growing season even if not needed for weed control. Weed control must be excellent.

E. Pest Control:

Pests must be controlled.

Good luck! When all these factors work together, and the weather is favorable, a big crop should result.

The next questions are how to harvest and store the crop effectively. Are driers needed? What kind of storage is needed? What can be done when there are two or three weeks of rainy weather? No one wants to produce a crop that can not be harvested. Pulling and drying the plants under shelter might be done on a small scale. There are many interesting problems, but I believe Guyana has the people that can find the answers.

A P P E N D I X B

U. S. Itineraries of the Guyanese Participants

Itinerary for Study Tour of Rowland Fletcher and Herman Adams,
Central Agricultural Station, Mon Repos, Georgetown, Guyana

August 1 to 2, 1975	--------	Travel from Georgetown, Guyana to Urbana, Illinois.
August 3 to 8, 1975	--------	Attend World Soybean Research Conference, University of Illinois, Urbana, Illinois.
August 9 to 10, 1975	--------	At Urbana, Illinois.
August 11 to 12, 1975	--------	Visit University of Illinois Agricultural Experiment Station - the soybean production fields in Central Illinois, soybean utilization researchers (Dr. C. N. Hittle will arrange details of these visitations).
August 13, 1975	--------	Visit with University of Illinois Staff members including INTSOY personnel.
August 14, 1975	--------	Depart 4:30 a.m. via University of Illinois plane for Stoneville, Mississippi. Arrive at Stoneville at approximately 8 a.m. Spend the entire day of August 14 at Stoneville, Mississippi (Dr. Edgar E. Hartwig).
August 15, 1975	--------	Depart Stoneville, Mississippi at 8 a.m. Arrive in Stuttgart, Arkansas at approximately 9 a.m. Visit the Hartz Seed Company and the University of Arkansas Substation at Stuttgart, Arkansas. Depart Stuttgart at approximately 4 a.m. to Memphis, Tennessee. At Memphis, Tennessee Airport drop off Rowland Fletcher and Herman Adams and proceed on to Willard Airport, Champaign, Illinois.
August 16 to 17, 1975	-------	Rowland Fletcher and Herman Adams proceed to Gainesville, Florida.
August 18 to 19, 1975	--------	Visit Florida Agricultural Experiment Station, Gainesville, Florida, (Dr. Kuell Hinson).
August 20, 1975	--------	Gainesville, Florida to Georgetown, Guyana.

Itinerary for Study Tour of Harri Persaud , Microbiologist
Central Agricultural Station, Mon Repos, Georgetown, Guyana

August 1 to 2, 1975	--------	Georgetown, Guyana to Urbana, Illinois.
August 3 to 8, 1975	--------	Attend World Soybean Research Conference, University of Illinois, Urbana, Illinois.
August 9 to 10, 1975	--------	At Urbana, Illinois and en route to Raleigh, North Carolina.
August 10 to 15, 1975	--------	Attend the North American Rhizobium Conference, Raleigh, North Carolina.
August 16 to 17, 1975	--------	En route to St. Paul, Minnesota.
August 18, 1975	--------	Visit the University of Minnesota (serology and and agronomic work in soybean). Dr. George Ham and E. L. Schmidt.
August 19, 1975	--------	Visit Nitragin Company (inoculant manufacturing) (strain testing) 3101 West Custer Avenue, Milwaukee, Wisconsin (Dr. Joe C. Burton).
August 20 to 21	--------	En route to and vis[illegible]g Research Seeds, Inc. 310 S. 3rd Street, St. Joseph, Missouri. Dr. A. A. Hendrickson, Dr. Forster Davidson).
August 22	--------	Visiting Central Illinois Soybean Production area.
August 23 to 24, 1975	--------	Travel to Knoxville, Tennessee via Urbana, Illinois.
August 24 to 29, 1975	--------	Attend American Society of Agronomy Meetings, Knoxville, Tennessee.
August 30 to 31, 1975	--------	En route from Knoxville, Tennessee to Washington, D. C. with the assistance of Dr. Lloyd Frederick.
September 1, 1975	--------	In Washington, D.C. - Labor Day.

September 2 to 3, 1975	---------	Visit Soybean Investigations USDA-ARS, Beltsville, Maryland (Dr. Deane Weber) (Dr. Charles Sloger).
September 4 to 5, 1975	---------	Visit Florida Agricultural Experiment Station - Soybeans and peanuts on sand - Gainesville, Florida (Dr. Dave Hubbell). Perhaps also visit Dr. Walt Scutter at Sanford, Florida which is 120 miles south of Gainesville, Florida.
September 6 to 7, 1975	---------	Travel from Florida to New Orleans, Louisiana.
September 8 to 10, 1975	---------	Visit the USW Louisiana Station -- rice, sugar cane, and soybean research. Lafayette, Louisiana (Lynn De Selle).
September 11 to 12, 1975	---------	Return to Georgetown, Guyana.