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CONSORTIUM FOR INTERNATIONAL CROP PROTECTION
PEST MANAGEMENT & RELATED ENVIRONMENTAL PROTECTION PROJECT*
ANNUAL REPORT
TO
AGENCY FOR INTERNATIONAL DEVELOPMENT
OCTOBER 1982 - SEPTEMBER 1983

Ray F. Smith, University of California, Executive Director

Member Institutions:

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- North Carolina State University
- Oregon State University
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INTRODUCTION

PROJECT REVIEW

The Consortium for International Crop Protection (CICP) was incorporated in August 1978 in the State of California by nine universities interested in combining their resources, talents, expertise and experience in a mutual effort to respond to the crop protection needs of developing countries and thereby assist them to reduce their food crop losses. In the five years since its founding, CICP has welcomed four additional universities and the United States Department of Agriculture as members. Together, these fourteen institutions participate in activities and projects that encourage and support the development and adoption of integrated pest management programs and that promote the safe and effective use of pesticides in these programs.

CICP is a public benefit, non-profit organization whose basic goal is to advance economically efficient and environmentally sound crop protection practices in less developed countries. Through a variety of interrelated activities, CICP assists government officials, administrators, scientists, farmers, etc. in these countries in planning, developing and implementing plant pest and disease control programs which minimize human health hazards and other adverse environmental impacts. Reflecting its concern and commitment to improve the living and health standards of people in the developing world, CICP's specific goals are:

- to increase and disseminate knowledge and understanding of integrated pest management and the economic, social, and educational aspects of international crop protection
- to develop and maintain an overview and current awareness of crop protection needs and problems in developing nations for the purpose of promoting the development and implementation of integrated pest management programs

- to promote coordinated interdisciplinary programs that utilize the combined expertise of the medical, nutritional, and agricultural sciences to improve the use and management of pesticides
- to initiate and cooperate in developing training programs and educational materials in crop protection and pesticide management
- to provide professional consultants to assess, evaluate, and implement specific crop protection programs, and
- to plan, conduct, and supervise research programs in crop protection and pesticide management

CICP operates under the overall guidance and direction of a fourteen member Board of Directors. The Board determines general policy, sets priorities and approves programs; it is composed of a representative from each member institution. Implementation of the Board's policies, management of the Consortium's programs and coordination of its activities is the responsibility of an Executive Director, assisted three technical staff and other administrative support staff. Consortium headquarters are located at an off-campus site near the University of California, Berkeley.

Principal funding for the Consortium's activities and programs is provided by the United States Agency for International Development (USAID). CICP provides technical advice and assistance on pesticides and pest management to developing countries for USAID pursuant to the terms and conditions of a general technical services contract with USAID headquarters in Washington, D.C. CICP also negotiated a cooperative agreement with the Agency's Bureau for Latin America and the Caribbean to provide the services of a Regional Pest Management Specialist, located in Guatemala. This is CICP's third annual report and covers

the period October 1, 1982 - September 30, 1983. Comments or questions about the information contained in this report may be sent to the Executive Director, Ray F. Smith.

Project Review

The National Science Foundation (NSF) was asked by USAID to conduct a review of the Pest Management and Related Environmental Protection Project in 1983 and assembled the following four member team of scientists for this purpose: Elvin F. Frolik, retired Dean of the College of Agriculture, University of Nebraska; Murray S. Blum, research entomologist, University of Georgia; Dale N. Moss, Head of the Crop Science Department, Oregon State University; and Alton N. Sparks, director of the USDA Southern Grain Insects Research Laboratory in Tifton, Georgia. The purpose of the review was to undertake a comprehensive examination of the project's operation and implementation by comparing its accomplishments and outputs to the cost of maintaining this type of service to the funding agency. A review of the objectives and priorities of the project was of considerable importance to USAID at this time because of the substantial interest in initiating broad pest management programs recently expressed by the agency's regional offices in Latin America (ROCAP) and Africa (REDSO/ESA).

At a meeting held at USAID headquarters in Washington, D.C. on March 14, the members of the review team were briefed on their assignment and given further guidance on the task they were to perform. At this briefing, they received a candid assessment of USAID's relationship with the project's management staff (CICP) and were informed that the project has operated more autonomously than other USAID projects and

that recent attempts on USAID's part to provide more direction had not been too well received. USAID also pointed out that this program was more costly than other similar projects. The team was requested to consider the effectiveness of the program in terms of money spent (especially from an administrative and management point of view) in light of the fact that USAID was facing problems on availability of adequate funds. In particular, they were asked to examine the project's staffing and methodology while investigating opportunities for efficiencies and ways to strengthen the program technically as well as from a management and operational point of view. Subsequently, the team was asked to recommend a minimum amount of "core" funding for the project.

Immediately following their briefing in Washington, the evaluation team visited CICP's offices in Berkeley, California for two days, March 15-16. During this visit, they received a summary presentation of project activities and programs by the Executive Director of CICP and conducted question-and-answer sessions with various staff members. In addition to these oral discussions, the team was provided a series of additional written materials and reports produced by the project. On the basis of the facts and impressions obtained during their on-site visit to CICP's offices and the information contained in the project's publications, the evaluation team came to a number of general conclusions about CICP's management and operations which were later translated into a series of short- and long-term recommendations. Among the more important findings and recommendations were the following:

- 1) USAID should establish a list of priorities developed from actual needs and requests from USAID Missions and then prioritize the 17

items of responsibility categorized in the Scope-of-Work of CICIP's contract,

2) CICIP might well adopt a higher degree of conformity with, and a more conciliatory attitude toward, USAID requirements and directions and should seek means to resolve differences in an expeditious manner,

3) The CICIP contract should be amended to be much more specific on budgetary matters and should dictate what is needed in the way of financial reports,

4) The contract should specify how the needs of developing countries are to be determined, how these are to be responded to, program details, and means of measuring results,

5) The number of full time technical staff should be reduced by one person,

6) An independent office "diagnostic" should be performed to provide an analysis of the structure and operation of the support staff and to formulate recommendations to increase their efficiency,

7) The contract should specify what is expected in the way of reports, both with respect to their content and dates of submission,

8) The number of lecturers used to conduct short courses and seminar/ workshops should be reduced and consequently, more output should be required of those making the presentations,

9) CICIP should be authorized and encouraged to encompass research activities in their programs,

10) Much greater use of personnel trained and experienced in extension and adult education should be made to plan and conduct training courses and to evaluate results,

11) Greater emphasis should be placed on demonstrations and "hands-on" technical assistance in the developing countries and less on seminar/workshops, and

12) Loose-leaf texts and other visual materials should be prepared for use in the training courses and demonstrations.

In their report's summary, the review team expressed the view that the net result of their recommendations would be that CICIP would operate primarily as a resource for technical information as requested, and secondarily, as an agency which could respond to personnel needs in the area of integrated pest management wherever these arise, under the assumption that finances would be available to provide these services. The team stated that during the course of their review they gained the impression that, outside of providing assistance in the preparation of project implementation documents (PID) and project papers (PP), CICIP tended to operate chiefly within its own programs and they suggested that a much higher degree of integration in the many other collaborative programs of foreign assistance was needed. In particular, they felt that CICIP could effectively be involved in ongoing and future programs such as the Collaborative Research Support Programs (CRSP), technical assistance programs in less developed countries by whatever government or agency, training programs conducted by the international agricultural centers, e.g. CIMMYT, and other programs. For this greater integration of CICIP involvement in additional relevant programs to be achieved, the team indicated that USAID would have to exert a determined effort to make generally known the resources of CICIP and their willingness to cooperate in a wide array of programs. Finally, the evaluation team recommended that, from a long-term standpoint, USAID should establish an

ad hoc study committee to review in depth the needs and important problems facing the less developed countries in the general area of integrated pest management and related matters. The committee would suggest the types of programs and organizational structures needed to solve the problems and best respond to the needs identified. They further recommended that such a committee be activated at the earliest possible date in order to have its report available well in advance of the termination date of the present contract.

RESPONSE TO USAID MISSION REQUESTS FOR TECHNICAL ASSISTANCE

SENEGAL

BOLIVIA

WEST INDIES

SRI LANKA

WESTERN SAMOA

WEST AFRICA

ST. VINCENT

SUDAN

EAST AFRICA

Analysis of Pesticide Use in the Senegal/USAID Casamance Regional
Development Project, Senegal, January 6-17,1983

This project was designed to develop the institutional capacity within Senegal to plan and implement a rational development program to increase agricultural productivity in the lower Casamance River Basin. The three components of this program consist of extension activities directed toward farmers, research for the development and testing of new varieties and technical packages, and field testing and seed multiplication activities. The use of a limited number of pesticides in this project had been approved earlier in a prior initial environmental examination; however, the pesticides approved were not highly toxic and all were to be applied under the direct supervision of trained technicians. Subsequently, an expanded list of pesticides for potential use in the project was submitted to USAID for review, and the latter determined that an environmental assessment of their possible impact was required. The person selected to perform this assessment was George A. Schaefers, entomologist, Cornell University, and he was asked to review the risks involved in the use of these pesticides by small farmers, the possible impact of this use on the character of the aquatic environment of the lower Casamance Region, and to suggest protective measures.

The project area is located in the southernmost part of the country and consists of a large area of tidal estuary and numerous tributaries and estuaries of the various arms of the Casamance River. Agriculturally, the area is primarily engaged in growing rice in the lowlands, around the river. Beneficiaries of the project live in about 15% of the total farm units in the lower Casamance with a total of

15,000 hectares devoted to rice, millet, sorghum, maize, groundnuts, cowpeas and vegetables.

In performing this assessment, Schaefers considered the following factors: the USEPA registration status of the requested pesticides, the basis for their selection, extent of their proposed use in an integrated pest management program, acute and long-term toxicological hazards, proposed methods of application, efficacy for the proposed use, conditions under which the pesticides were to be used, provisions made for training users and applicators, etc. On the basis of his analysis of these and other factors, Schaefers specified in his report which of the pesticides requested were approved for use in the project. All the pesticides authorized for use have either a valid USEPA registration and/or a Maximum Residue Limit or Accepted Daily Intake level established by the joint FAO/WHO Expert Committee on pesticide residues.

The specific pesticides which had been requested from USAID had been chosen by the project's plant protection specialist in consultation with several crop protection organizations in Senegal; their decision followed a review of the chemicals used on rice in the United States and elsewhere and were based on the likelihood of their present, as well as future, availability in the country. With two exceptions, the pesticides Schaefers authorized for use in this project were those which are registered for use without restriction in the U.S. for the crop uses specified in the environmental assessment.

Although stating there was no research program in the region emphasizing the integrated pest control approach, Schaefers discussed various alternative crop protection control methods that were being explored. He considered it vital that the project attempt to anticipate

problems from secondary pest outbreaks by selecting and using pesticides which have the least likelihood of affecting natural enemies. As the use of resistant varieties was receiving increased attention within the project, he recommended that relationships with plant breeders at WARDA, IITA, and others be further strengthened.

The pesticides which were requested were presumed effective under conditions of the lower Casamance, and all are widely used, non-experimental compounds with recognized efficacy against specific pests. However, the project's crop protection specialist was to perform limited adaptive research to further evaluate their efficacy and to determine optimal timing, dosage and means of application. The toxicological hazards of these pesticides were closely examined and led to the disapproval for use of a nematocide and methyl parathion.

In his report, Schaefer stated that the seafood industry is vital to the area and must not be endangered through pest control activities. He felt that the anticipated use of pesticides on vegetables was not expected to introduce risk to the aquatic environment and attributed this to the limited use of pesticides for this purpose, their application by trained applicators and to the occurrence of vegetable production in irrigated, upland areas some distance from natural waterways. As a number of pesticides authorized for use on rice are highly toxic to fish and shrimp, he considered it essential for project personnel to be thoroughly educated to the hazards of waterway contamination. Specifically, he urged that applicators should be alerted to the hazards associated with filling sprayers, washing equipment, themselves, etc. in waterways.

Schaefers also noted that the use of pesticides in vegetable plots presents a special risk as the plots are maintained almost entirely by women, often with infants on their backs, and by young, pre-school age children. He stressed that a number of precautions to reduce this risk should be taken, including: use of the most innocuous pesticide consistent with reasonable efficacy, removal of people from the area during treatment, and marking of the treated plots to prevent reentry for 24 hours.

At the conclusion of his report, Schaefers listed a number of specific actions involving seed treatment and storage and pesticide storage which should be taken by the project to conform to USAID regulations. Additional recommendations made by Schaefers were for the project to be reviewed annually to evaluate current pesticide practices and changes which might lead to higher risk levels in the sensitive aquatic environment; for the initiation of fee charges for applications on farmer plantings to help reduce potential and unnecessary "insurance" treatments; and for augmenting the training program for pesticide applicators with USAID-endorsed "Train the Trainer" programs.

Chapare Integrated Rural Development Project, Bolivia, January 6-February 5, 1983

Plans for this development project emphasize agricultural production, marketing and agribusiness, infrastructure improvement and institutional development for the Chapare region of Bolivia. The planning document was prepared by the USAID Mission in La Paz in May 1982 and sent to Washington, D.C. for evaluation and approval. USAID officials reviewed this document and then recommended that a series of technical,

environmental and economic analyses be carried out to assist in the further design of the project. These analyses were to be performed by a team of multinational experts in various fields of agriculture and economics, and CICP was asked to provide the pest management specialist member of the team. Entomologist B. Austin Haws of Utah State University was subsequently selected to conduct the environmental assessment for this project.

The objective of these evaluations was to analyze the considerable amount of reference material available on the Chapare, compare it with observations and information obtained in the field, discuss it with Mission and Bolivian counterparts, and then synthesize it into an economically and ecologically sound development program for the Chapare region. As a member of this evaluation team, Haws operated rather independently of it during most of his four week assignment; however, he did spend four days travelling with other team members as they visited experiment stations, nurseries and a number of small farms and ranches in the Chapare. For the remainder of his stay in Bolivia, he was frequently accompanied by J. Daniel Candia, Vice-Rector of Universidad Gabriel Rene Moreno, Santa Cruz, who greatly assisted him in obtaining valuable reference material from government agencies, educational institutions and private sources, and who also served as co-author of the report prepared for the environmental assessment.

Nearly a third of this report was devoted to a discussion of the current crop protection situation in the region, with separate sections on the principal agricultural insect pests, stored grain pests, livestock pests, major weed species, pests that annoy humans, and plant diseases. A list of the principal pest species in the different cate-

gories was compiled and presented in tabular form. Pesticide use and management practices were also discussed at some length, and it was stated that the Chapare farmer seemed to have little awareness of safety precautions needed when pesticides are being applied and no conception of delayed action or residual effects of pesticides. However, the report affirmed that Bolivia did have comprehensive legislation that, if enforced adequately, should minimize the risks to humans derived from an increase in pesticide use.

As pesticides were to be used in this proposed development project, Haws provided a list of acceptable or recommended pesticides for this purpose. The pesticides proposed for use had been selected because they had been proven effective and relatively safe for applicators under conditions prevailing in the subtropics of Bolivia and elsewhere in South America and because they were registered by the U.S. Environmental Protection Agency and the counterpart Bolivian government agency. Pesticides that had been cancelled, withdrawn, suspended or that were under the RPAR process in the U.S. had been eliminated from consideration. Pesticide applications were to be made, or supervised, by project researchers or permanent technical field staff, all of whom were to receive instruction in the safe use of pesticides.

In the report, Haws stated that not enough pesticide research had been done in the Chapare to serve as a basis for an effective integrated pest management program nor had economic criteria for pest control been established; consequently, he recommended that management strategies, adhering to the IPM philosophy, be researched, developed and applied for use on small farms. These strategies were to consist of biological control by beneficial insects; mechanical or cultural control, using

crop rotation, resistant varieties, etc.; and chemical control, using pesticides selected on the basis of their efficacy, safety to the applicator and reduced environmental risks. A number of specific recommendations, relating to the establishment of an IPM program, were cited in the report, including:

- 1) establishment and maintenance of a formal insect collection, as well as small collections in several areas, to provide a center for pest identification,
- 2) initiation of programs in biological control,
- 3) initiation of studies of the basic biology of pests in the Chapare region,
- 4) evaluation of short-term pest control techniques,
- 5) establishment of both short-and long-term training programs in pest management, and
- 6) provision of adequate, long-term funding for all phases of an improved research and extension program for the Chapare region.

Technical Assistance on Pesticide Use, Residue Monitoring and Crop Protection in Barbados, Dominica and St. Lucia, February 8-25, 1983

CICP Crop Protection Specialist, Dale G. Bottrell, visited the West Indies in February to provide assistance on the use of pesticides in St. Lucia, the establishment of a pesticide residue monitoring program in Dominica and the development of a manual on crop protection in Barbados. In Dominica, he held talks with personnel of the Ministry of Agriculture, Lands, and Cooperatives (MALC) and the Pesticide Control Board in response to their request for assistance in the establishment of a pesticide residue monitoring program. Concern about the hazards to

farmers and workers exposed to organophosphate pesticides had developed and the Board members were interested in obtaining quantitative data on the magnitude of the problem by monitoring cholinesterase levels in the blood of persons handling these pesticides. There was also interest in undertaking a program for monitoring pesticide residues in water and food crops. As the expertise to conduct this program was not available in Dominica, the Ministry wanted to have their chemist trained in the area of comprehensive pesticide analysis, pesticide quality control and residue monitoring at the University of Miami in Florida. Bottrell agreed that this training was necessary but he also felt that before this individual receives such training that it would be advisable for the director of CICP's Quality Control Program in Miami to visit Dominica in order to evaluate their equipment, personnel and supply needs and to provide assistance in the planning, preparation and organization of their proposed monitoring program.

The principal objective of his trip to St. Lucia was to prepare a detailed report on pesticide management for inclusion in an Environmental Assessment that had previously been prepared for the St. Lucia Agriculture Structural Adjustment Project. In this report, he made specific recommendations regarding pesticide use in the project and also discussed initiatives for training, research and monitoring which would ensure the safe and legal use of pesticides, promote sound environmental practices and facilitate the development of long-term, cost effective crop protection. These recommendations were to be implemented by the St. Lucia Pesticide Control Board which was created in 1982 following passage of the Pesticide Control Act by the legislature. This Act makes provisions for the control of the manufacture, sale, importation,

storage and use of pesticides and is potentially a very effective mechanism for controlling the importation of unsafe pesticides; however, Bottrell stated that lack of resources and personnel were impeding the Pesticide Control Board from developing regulations and enforcement procedures. Thus, he felt that the project, by training enforcement personnel and providing technical assistance and supplies, presented an opportunity to stimulate activities specified in the Pesticide Control Act. Furthermore, the initiatives he proposed were intended to assist the overall efforts of the project to increase crop production, reduce costs of inputs, and seek out export markets.

In Barbados, Bottrell met with personnel of the Caribbean Agricultural Trading Company (CATCO) to discuss production of a crop protection manual for CATCO customers that describes proper pest management practices and pesticide safety measures. Development of this manual had been proposed in an Environmental Assessment document prepared by another CACP consultant in July 1982. A major issue discussed with CATCO officials was the desirability of producing two or three short manuals rather than preparing one long manual of circa 100 pages. Other matters that were discussed in these meetings at CATCO concerned funding sources, budget, printing, editing, and distribution of the manual. Although these discussions did not produce any definitive decisions regarding the manual, they did serve the useful purpose of establishing areas of agreement as to principal sources of funding and determining the principal target audience for the manual.

Biological Control of Insect Vegetable Pests, Sri Lanka, March 26-
April 10, 1983

CICP consultant Leopoldo E. Caltagirone, entomologist, University of California, Berkeley, went to Sri Lanka to evaluate the merits and potential of a proposal for the development of a biological control project for vegetable insect pests that had been submitted to USAID for funding by the head of the Division of Entomology, Central Agricultural Research Institute (CARI). This evaluation was conducted through interviews with entomologists and vegetable crop specialists at CARI, Peradeniya and farmers in the Kandy area and also by reference to scientific publications and unpublished reports that provided information on the pest control practices being applied in vegetables in Sri Lanka. These interviews and literature references indicated that insect control programs on vegetables relied almost exclusively on the use of chemical pesticides. The amount and frequency of application of these chemicals suggested that their use was excessive and that the implementation of a research program to improve these crop protection practices was badly needed.

The objective of the proposed project was to investigate and implement a biological control program of selected insect pests of vegetables grown in the mid-country highland region of Sri Lanka by conducting field studies of the pest populations, establishing a biological control laboratory and importing and releasing natural enemies of the pests. In Caltagirone's opinion, the project had the potential to develop valuable information for a program that would control pests effectively with a minimum use of pesticides. He believed that the kind

of research envisioned could adequately be performed in the space available at the CARI institute since the CARI grounds were large enough to allow for the setting up of all the experimental field plots needed, while additional plots could be located in nearby farms.

He stated in his report that it would be premature to develop a quarantine facility for the importation of natural enemies at that time because there did not appear to be any individuals sufficiently trained in quarantine procedures to justify its establishment. Although there was no facility to mass culture insects at the institute, space for the future insectary had already been designated on the ground level of a glasshouse. He considered the personnel resources the most crucial aspect for the success of the project and, in his estimation, the personnel at CARI, although very enthusiastic and with the basic knowledge required to conduct research in crop protection, lacked the experience necessary to bring the project to fruition in a reasonably short time. Consequently, he believed that it was very important to have experienced people directly involved in the program as advisors, at least during the initial stages, and he felt sufficiently strong on this matter that he stated that he would not recommend approval of the project if the participation of a qualified consultant was not included.

Caltagirone declared in the report that carrying out research intended to modify pest control practices for the main pests of all five crops indicated in the project, i.e., cabbage, tomato, beans, cucurbits and eggplant, would be an unrealistic and frustrating approach and that it would be better to concentrate the effort on the more important pests of a couple of crops. He cited the diamondback moth on cabbage and the eggplant fruit borer as good candidates, although he stressed that

research should not be limited to these species but rather should also include the other species that form the normal complex on each crop. The approach that should be taken, in his opinion, should be toward the identification of the conditions that determine the incidence of a pest and, if natural enemies are an important part of these conditions, their importation and/or their manipulation to maximize their controlling effect on the pests should be studied and tested. He emphasized, however, that although the importation of parasites, predators and pathogens to control these pests should be attempted whenever the needed beneficial species are available, foreign exploration and quarantine processing of field collected exotic material should not be attempted under this program until adequately trained personnel and the required quarantine facilities are available in Sri Lanka.

Concluding the evaluation of this project, Caltagirone appended a modified version of the original proposal to his report in which the various ideas and suggestions he had discussed earlier were incorporated. He then recommended that financial support from USAID be given to conduct the research, as detailed in the revised proposal. He also recommended that the project be approved for 3 years with the possibility of extending it for an additional three year period.

Safe Handling and Disposal of Toxic Chemicals and Containers, Western Samoa, May 6-17,1983

At the request of the USAID South Pacific Regional Development Office in Fiji, CICP was asked to provide assistance to the Samoan government and undertake an evaluation of the problem of waste pesticide

and container disposal and possible chemical contamination of the Western Samoan environment. There are many small land holders on the island and many of the chemicals that are brought into the country are in small containers (one to five liters); consequently, there are a large number of small plastic or metal containers that require disposal after use. As no appropriate disposal site or method for their safe disposal had yet been developed, the existence of these containers was perceived as a problem in the country. Accordingly, CACP asked Ray Krueger of the U.S. Environmental Protection Agency in Washington, D.C. and Virgil H. Freed, an agricultural chemist with Oregon State University, to travel to the island and assess the situation.

In their efforts to gather information and make observations on the potential hazard of pesticide use on the island, the two men visited the wharf where the imported chemicals arrive, the principal commercial outlet for these chemicals (called the Agricultural Store), the latter's warehouse, agricultural experiment stations and several small farms and plantations. On the basis of these visits and the information obtained, they offered a number of suggestions for initiating a program to deal with the various problems they encountered.

In their visit to the Agricultural Store in Apia, they inspected the receiving, storage and main retail outlet areas and found a number of deficiencies, among which was a lack of adequate ventilation, corroded and leaking containers, and lack of a wash area for workers. As corrective measures, they recommended that turbine ventilators be installed, a wash station be developed for employees and sawdust be provided to scatter on the floor to absorb spills. When they visited the

Store's warehouse, they found additional problems, including a drain that did not function adequately and many containers in need of disposal. They suggested the installation of a separate drain for chemicals and the construction of an incinerator as a means to improve the situation.

The two men toured an agricultural region where breadfruit, coconut, passion fruit and taro grow in abundance and visited several small farms to inquire about container and chemical disposal practices. In speaking to the growers and plantation managers, they were assured that the former were aware that the containers should not be used for other purposes, but instead should be disposed of in a safe manner. Some of the growers informed them that the containers were buried on the farm, yet the two men observed instances where containers were lying about outside a locked storage area or caught up in banana trees.

A number of people with whom Freed and Krueger talked, including the head of the Department of Crop Production at the University of the South Pacific, the director of the Samoan German Crop Protection Project Experiment Station and the Minister of Agriculture, expressed a real concern about the problem of pesticide pollution in the environment. In order to obtain data that would indicate the severity of the problem, the two men collected water samples from three sites: a pumping station, the inlet of one of the major water supplies of the city of Apia and the spring headwaters of the inlet. The samples were treated with activated charcoal, then filtered to remove the carbon after which the carbon was shipped to Oregon State University for analysis. The carbon samples were analyzed to determine whether residues of the herbicide,

paraquat, were present; however, to the limits of sensitivity of the method used (0.01 ppm), no trace of the chemical was found.

The two consultants also visited the wharf area in Apia and were shown the receiving warehouse and quarantine fumigation shed. They noted that there did not appear to be any safe storage area for the chemicals in the warehouse or dock area nor was there any provision for safe disposal in the event of spills of chemicals. They recommended that a separate, locked storage area for all chemicals (with suitable drainage) should be provided, as well as a disposal method in the event of a spill.

In an appendix to their report, the two men discussed a proposal to establish a pesticide container and chemical disposal site at the Westec Corporation coconut plantation and offered a number of suggestions for consideration in its development. Among their more important recommendations, they emphasized that if the disposal site is established, then it was essential to put an effective security fence around the area. They also stated that a 12-15 inch berm or dike should be constructed inside the security fence to contain runoff, an adequate supply of water should be piped to the disposal area and appropriate protective clothing and supplies of charcoal and/or lime should be made available for treatment of spills.

Termite Control in Agricultural Crops in West Africa, June 5-July 3, 1983

In an effort to increase their ability to respond to requests for technical advice and assistance on the control of termites from their missions in Africa, USAID officials in Washington asked CICP to provide

a consultant to review termite problems in selected areas of Guinea - Bissau, Niger and Senegal and evaluate the following:

- (1) termite control in agricultural situations, including broadcast and mound treatments,
- (2) chemical treatments (other than chlorinated hydrocarbons) to protect seedlings and planted seed,
- (3) postharvest protection of crops left in the field, and
- (4) protection of seedlings in forestry nursery projects

The individual selected for this assignment was Raymond H. Beal, principal entomologist, USDA Forest Service, Southern Forest Experiment Station, in Gulfport, Mississippi.

For the preparation of this evaluation, it was suggested that he summarize the current state of knowledge about the nature and magnitude of termite problems, propose technical approaches for resolving the key issues, assess the relative suitability of newer insecticides, determine safe and effective treatment methods, and consider other issues and information that might improve the technical assistance that is provided for coping with termite problems as they occur in Africa. Prior to visiting these West African countries, Beal went to London to meet with scientists of the Tropical Development and Research Institute and hold discussions with their staff to exchange information and opinions about the results of their research and experience in working in West Africa. This visit was particularly fortunate because Beal had an opportunity to meet with a TDRI staff member who had just completed a survey of termite damage to groundnuts in Niger, and had found that termites pose very few problems to this crop in that country.

Following a brief stay in England, Beal travelled to Guinea-Bissau, Niger and Senegal to observe termite problems in forest tree nurseries and field crops. He found that the termites most prevalent in the areas he visited belonged to the subfamilies Macrotermitinae and Termitinae in the family Termitidae, and were all fungous-growing species. These species live either in mounds aboveground or in subterranean nests in complex, diffuse systems that leave little or no indication of their presence on the surface of the soil. However, at the time of his visit, fields were just being planted and no termite damage to agricultural crops was observed. He was asked to suggest control practices for a large mound building termite (probably Macrotermes sp.), but from the information he obtained in London and reports in the literature, it seems that this species does not extensively damage crops. Research by TDRI staff demonstrated that the most serious crop damage can occur from species of subterranean termites in the genus Microtermes.

Although no insecticides are apparently being used to control termites in field crops in these countries, he noted that the Department of Agriculture in Niger was using a fungicide-insecticide combination to treat seeds which, because of the insecticide used, would prevent termite attack on the seeds. There were tree planting programs underway in both Guinea-Bissau and Niger, and Beal recommended that insecticides be incorporated into the soil at the planting site to reduce the possibility of termite attack on the seedlings. He felt that because of the limited amount of insecticide needed, there should be no long-term effects on soil fauna from its use.

In his report, Beal stated that termite problems in crops do not appear serious enough to justify the use of insecticides and, in view of

low yields and value of the crops, he suggested they not be used. He felt that other measures to control these insects should be tried first and recommended the following practices: (1) prompt harvest of crops after maturation, (2) removal of crop residues and debris, (3) hoe weeding or ridging soon after a period of rain, and (4) rotation of susceptible crops with those less readily attacked.

Agricultural Development Project, St. Vincent, West Indies, June 26-
July 14, 1983

The principal purpose of this project was to support a variety of activities that would lead to an increase in the production and marketing of three primary crops grown for export: carrots, peanuts and sweet potatoes. These activities were to include:

- 1) identifying and disseminating improved technologies through adaptive research, technical assistance, and extension,
- 2) providing production and storage inputs (fertilizers, pesticides, planting and harvesting equipment, and storage facilities) and credit required to mobilize these technologies,
- 3) developing associations of producers, and
- 4) strengthening producers' and exporters' markets.

The Project Identification Document (PID) recommended that an environmental assessment be conducted to examine the proposed project actions that represented potentially adverse impacts on the human and natural environment, especially in regard to the use of pesticides. The individual selected to perform this assessment was CICP crop protection specialist, Dale G. Bottrell.

In his report, Bottrell stated that pesticide use represents the potentially most serious environmental hazard of all project actions and that minimizing these problems will require the collaborative efforts of regulatory, educational, and research personnel as well as farmers. He felt that the project could contribute significantly in reducing the existing pesticide problems and preventing the occurrence of new ones if safeguards were to be established at an early stage in the development of the project. He proposed a number of initiatives in training, extension, monitoring and regulatory action to assist in the establishment of these safeguards.

Implementation of the project was to involve research and training in the development of integrated pest management and pesticide management. The research program was to include a search for insect and disease resistant varieties of carrots, peanuts and sweet potatoes; crop rotation schemes that disrupt pests affecting these three crops; pesticide application techniques that protect natural enemies; and certain other aspects of integrated pest management. The project was also to support research on the use of cultural practices and other nonchemical methods known to be effective against pests. In addition, it was to support research aimed at securing cost/benefit information on pesticides and alternative control methods.

After considering a number of factors associated with the proposed use of pesticides in the project, such as conditions under which the pesticides were to be used, proposed methods of application, acute and long-term toxicological hazards, efficacy for the proposed use, the USEPA registration status of the proposed pesticides, etc., Bottrell provided a list of eleven pesticides that he felt were suitable for

general or supervised use in the project. He stressed that project personnel should examine the list to determine if additional pesticides would be required and, if so, then they should notify USAID's Regional Development Office in Bridgetown, Barbados of their supplemental requirements. All of the pesticides cited on the list were already being used in St. Vincent.

Bottrell also reviewed St. Vincent's ability to regulate or control the distribution, storage, use and disposal of pesticides and, in his evaluation, discussed that island's Pesticide Control Act of 1973. This Act provides for the control of the importation, sale, storage, and use of pesticides and empowers the Governor General to develop pesticide regulations and enforcement. The Act also provided for the establishment of a Pesticide Control Board to advise the Governor General on pesticide matters and to enforce the pesticide regulations. However, he found that the Board had not yet been established, nor had the regulations been developed or enforced. Consequently, he viewed this situation as an opportunity for the project to stimulate activities provided for by the Pesticide Control Act through the appointment and training of appropriate enforcement personnel and the provision of technical assistance and supplies. Additional actions which he believed could be taken by the project to mitigate expected adverse effects of the use of pesticides included the following:

- 1) appointment of a Pesticide Coordinator to monitor pesticide use and to coordinate training, extension, and other project activities required to ensure correct and safe use of pesticides,

2) employment of two inspectors/trainers to assist in the development and implementation of pesticide regulations and enforcement procedures provided for in St. Vincent's Pesticide Control Act of 1973,

3) purchase of safety devices and protective apparel required to ensure safe handling of pesticides and other agricultural chemicals,

4) in-country training in pesticide management for extension officers, health officers, nurses and other medical personnel which would emphasize practical aspects of pesticide safety, monitoring, application, disposal, recognition of symptoms of pesticide poisoning and appropriate treatment, etc., and

5) presentation of short courses in integrated pest management for agricultural extension and research personnel.

Evaluation of Integrated Pest Management Program on Cotton in the Sudan,
July 17 - August 11, 1983

In April 1983, the Minister of Agriculture and Irrigation of the Sudan made a formal request to the USAID Mission in Khartoum for financial assistance in the procurement of 1,117 tons of pesticides for use on cotton grown in the Gezira and Rahad projects. The pesticide specifically requested to be purchased was Temik[®] 15G, a carbamate pesticide produced by the Union Carbide Agriculture Products Company, Inc. In the Sudan, its use would be primarily for the control of a whitefly pest on cotton, Bemisia tabaci Genn., although it could also control other insect pests, nematodes and mites. However, there are a number of drawbacks associated with the use of this pesticide, such as its high toxicity to humans and other warm-blooded animals, its potential for contamination of water supplies and its ability to induce the outbreak

of secondary pests; because of these negative aspects, the USAID Mission asked CICP to conduct a technical review of its proposed use in these agricultural projects and make recommendations which would mitigate its adverse effects.

In response to this request, CICP sent a team of four individuals to the Sudan to evaluate the problem of pest control in cotton. This team was composed of Gerald A. Carlson, agricultural economist, North Carolina State University; Joseph X. Danauskas, analytical chemist, University of Miami, Florida; Donald W. Grimes, soil and crop management specialist, University of California, Parlier and Harold T. Reynolds, entomologist, University of California, Riverside. The evaluation team proceeded to obtain a broad and comprehensive picture of the pest control situation on cotton in the Gezira through interviews with numerous officials and technical personnel of the Sudan Gezira Board, Agricultural Research Corporation of the Ministry of Agriculture and Irrigation, Rahad Agricultural Corporation, Blue Nile Health Project, Union Carbide Agriculture Products Company and other organizations; from literature sources and by several on-site visits. Based on the information gathered by these methods, they prepared a 55-page report which evaluated the development of integrated pest management on cotton in the Gezira and discussed in particular detail the proposed use of Temik[®] for the control of the cotton whitefly.

As a consideration of the historical, organizational and political changes that have occurred in management of the agricultural area of the Gezira would be useful for understanding the present pest control crisis in cotton, a brief outline of these aspects is presented below:

The Gezira is an important agricultural region in the Sudan and has

been the mainstay of the country's economy for many years. It is an alluvial plain situated south of the confluence of the Blue and White Nile rivers at Khartoum. Climatologically, it is located in a zone of semi-desert, but water is available for large-scale irrigation from a dam on the Blue Nile. At present, there are approximately 840,000 hectares of land under cultivation. Each year, about a quarter of this area is planted to cotton, in a rotational sequence involving wheat, groundnuts, sorghum and vegetables; a fallow period is practiced also in part of the region.

The land is owned by the government, cultivated by approximately 100,000 tenants, and centrally administered. It is the largest agricultural scheme in the world under one management and combines state ownership of land and water resources with a tenant private enterprise system. Management of the scheme was under the direction of the Sudan Plantation Syndicate until 1950 when it was nationalized and the Sudan Gezira Board was established to direct operations. In 1981, the partnership system was replaced with a system wherein land and water costs are made to the tenant for each crop grown.

The size of a tenancy of cotton is 4.2 hectares. Under the existing production relationship, the tenants are responsible for most aspects of crop husbandry, but not for crop protection. Responsibility in this latter area rests with the Sudan Gezira Board through its Crop Protection Department. Recommendations on choice of pesticides for crop spraying and modes of application are issued by the Agricultural Research Corporation of the Ministry of Agriculture and Irrigation. Following the end of the second World War, the use of DDT to control the principal cotton pest, the jassid Empoasca lybica de Berg., was intro-

duced, and this practice soon became commonplace. Maximum benefit from this pesticide was obtained by application early in the growing season. Until 1960, pest control on cotton was primarily limited to this single early-season application. Around this time, DDT was no longer considered effective and infestations by the whitefly were also becoming more and more severe. Alternative insecticides were tried and widely adopted until about 1963 when severe infestations of the American bollworm, Heliothis armigera (Hubner), began to occur. With this development, the use of insecticidal mixtures which were capable of controlling the jassid/bollworm/whitefly complex was introduced. Although this tactic effectively suppressed the jassid, the overall pest situation worsened, especially in relation to the whitefly, bringing about an increase in the average number of sprays per season, from one in 1960-61 to eight in 1980-81.

Control of these three major cotton pests was exclusively based on aerial applications of insecticides and, during the 1970's, two principal approaches were adopted for conducting the spraying. These approaches were widely known as the "conventional method" and the "package deal". In the conventional method, the Sudan Gezira Board assumed responsibility for policy formulation and execution of crop protection measures. It purchased chemicals and contracted for aerial applications while decisions on timing of applications and choice of insecticides were made on the basis of scouting reports provided by group entomologists. The package deal refers to a contractual agreement between the management of a cotton growing scheme and an agrochemical company wherein the latter assumed responsibility of all operations for control of insect pests and guaranteed a certain minimum yield. Payment for

these services was in the form of a fixed rate per unit area. After the adoption of the package deal system as a commercial practice in the 1972-73 season, the area managed by a contractor company increased to a maximum in the 1978-79 season, when nearly half of the Gezira, and substantial portions of other schemes, were involved.

Dissatisfaction with both of these control strategies developed, however, and continued to grow during the decade of the 1970's because of the rapidly increasing severity of whitefly infestations. Finally, at the end of the 1980-81 season, after much of Sudan's irrigated cotton had suffered from heavy, largely uncontrollable whitefly outbreaks, a ministerial decree was issued proscribing all use of DDT and DDT-containing mixtures for cotton pest control and also prohibiting package-deal contracts.

Prior to their departure for Africa, the four CACP consultants were given a broad overview of the whitefly problem on cotton and the proposed use of Temik® in the Sudan in meetings with USAID officials in Washington, D.C. After their arrival in the Sudan, they further familiarized themselves with the complexity of the situation through visits to cotton fields in the Gezira and Rahad schemes, interviews with numerous government officials and other individuals, and a review of literature sources. Presenting their findings and recommendations in a 55-page report, the evaluation team stated that difficult pest control problems on cotton were not unique to the Sudan, having been recorded in many other parts of the world with such consistency that a familiar pattern of cotton production developed. This recurring pattern was distinguished by a spiraling use of pesticides for pest control, an eventual reduction in their effectiveness because of pest resistance,

enhanced secondary pest problems, ecological upsets, increased costs, and often a decline in lint and seed yields. They also declared that a successful recovery from the undesirable situation just described also demonstrated a recurring pattern involving the development of multiple tactics to manage populations of the complex of pest species rather than reliance and overdependence on any single control technique.

The team's report devoted equal consideration to an analysis of the economic aspects involved in cotton production, a review of integrated pest management principles and the development of IPM strategies in the Sudan, and an evaluation of the physical factors involved in crop management, i.e. soil, water and nitrogen, as it relates to cotton production. The section of their report on the economics of production included a discussion of incentive structures, methods of payment, cost recovery, farm-gate pricing, etc.; this was followed by the presentation of capsule summaries of the status of important pests and diseases on cotton in the Sudan, accompanied by a discussion of economic thresholds, host plant resistance, biological control, cultural control and research on insecticides; the report continued with a discussion of the influence of water-soil-plant interactions on the development of pest populations and plant growth. In their analysis of the physical characteristics of the soil in the Gezira, the team discussed the anticipated distribution of Temik[®] in the soil; they concluded that the concentration of Temik[®] at varying soil depths should closely parallel changes in the volumetric water content of the soil and that, because of the unique restriction of the Gezira clay soil to downward flow, together with clay surface adsorption of the pesticide, the possibility of groundwater contamination appeared essentially nil.

The final section of the CICP's team report contained several suggestions and recommendations for the conduct of specific research which they felt should be performed in order to correct or improve various problems they had identified, e.g., regarding the use of cotton as forage for livestock, excessive water demand among competing crops, soil compaction, water delivery schedules, etc. As great concern was felt by Sudanese and other involved officials regarding the potential effects on human and animal health and upon the environment from the scheduled use of Temik[®] on 160,000 feddans in the Gezira and 30,000 feddans in the Rahad scheme in the 1983-84 season, the CICP evaluation team presented a detailed plan in the report for monitoring the movement of this chemical in various substrates as a means to allay their concern.

The applications of Temik[®] were scheduled to begin on September 15, 1983; therefore, the report recommended that a three-person health and environmental monitoring team and a two-man biological monitoring team should be in place in the Sudan on or before that date to undertake the studies necessary to determine the fate of the residues of this pesticide in the environment. These studies were to last throughout the application period of 4-6 weeks as well as an additional two to four weeks afterwards. A decision to continue the monitoring for a longer period would depend on the results of the early studies. The three-person team was to be composed of an M.D. epidemiologist, residue analyst and an individual experienced in obtaining samples of blood, urine, plant, water and soil while the two-man biological monitoring team was to consist of a senior scientist well-experienced in cotton IPM and another well-trained scientist. The primary focus of the latter team

was to monitor the effects of Temik® upon the pest and beneficial fauna in the cotton ecosystem. They were also to conduct a plant growth analysis at weekly intervals to chart the effect of Temik® on plant growth and fruiting and to study the effect of whitefly and jassid control on the plant.

The CACP evaluation team also recommended the initiation in 1984 of a five-year study to develop an IPM program on cotton in order to increase cotton production and ensure less costly and more permanent plant protection. This study would bring all aspects of crop management and production, including plant protection, into a cohesive, holistic program and would coordinate existing research data and identify further research needs. They recommended that an Executive Committee be formed of a group of Sudanese scientists to develop the program and allocate grant funds for conduct of the research. Two senior U.S. advisors would work with the Executive Committee during occasional visits to the Sudan. The study would be carried out by a group of Sudanese nationals with the assistance of several support personnel and a number of short-term expatriate consultants.

The report also suggested that support be developed to establish a department of agricultural economics at the main research station in Wad Medani and the University of Gezira whose purpose would be to improve evaluation of recommended agricultural practices for the agricultural corporations and the small farmers. This department would consist of four professionals (2 Ph.D.'s and 2 M.Sc.'s) who would be responsible for production, marketing, finance and economic analysis of changes in incentive structures in the irrigated sector of Sudanese agriculture and

who would also give advisory services to the Ministry of Agriculture and Irrigation and the Ministry of Finance and Planning.

Regional Planning for Pest and Pesticide Management Workshop, East Africa,
July 25-August 13, 1983

CICP crop protection specialist, Patricia C. Matteson, travelled to Kenya and Zimbabwe during the period indicated for the purpose of assisting the USAID Regional Economic Development Services Office/East and Southern Africa (REDSO/ESA) in the development of plans for the presentation of a regional workshop in pest and pesticide management. However, when she arrived in Kenya, she found that there was a considerable difference of opinion among the USAID officials she met concerning the proposed workshop's objectives, subject matter and scope and her assignment developed into a task of holding discussions with diverse crop protection and pesticide management personnel within USAID and national institutions to determine current problems, needs and information gaps in the area of small farmer food crop protection and pesticide safety and to identify means by which REDSO/ESA could set priorities for making a positive regional contribution in these areas. She was informed that the presentation of a pest and pesticide management workshop should be regarded as only one possible way of identifying crop protection priorities for REDSO and that she should investigate others as well.

Accordingly, in response to this change in the purpose of her trip, she spent two weeks in Kenya and one week in Zimbabwe conducting interviews with a number of plant protection personnel. Most of the latter were negative toward a general regional workshop covering broad topics

in pest management, especially since the participation from each country was to consist of only two or three representatives. They considered that this kind of workshop tended to deal in ideas and generalities that do not get translated into concrete programs. In concert with this view, USAID officials in particular overwhelmingly requested in-country, intensive training courses and workshops for field personnel and/or researchers that would focus on specific topics previously identified through consultation between USAID staff and national crop protection workers and policy makers.

Dr. Matteson also discussed the employment of a regional pest management specialist (RPMS) by REDSO/ESA as another manner for obtaining the identification of priority crop protection problems. This individual would be well placed to perceive regional needs and could respond to USAID Mission requests for technical assistance in the area of pest management. She suggested that this person could be placed in charge of a regional cycle of national workshops or given responsibility for prioritizing pest problems through the process of consultation mentioned earlier. In addition, the RPMS could prepare Initial Environmental Examinations and Environmental Assessments for USAID projects in the region, provide technical backstopping for these projects and supervise, organize and spearhead regional pest management activities.

Every interviewee was asked about aspects of small farmer food crop protection and pesticide management activities which needed more attention and support, and, from their responses, there appeared to be a strong consensus for extension and farmer training; training for researchers, at least to the M.S. level; improvement in the control of livestock and postharvest pests; and information and training in pesti-

cide management, including proper labelling and package size and information about the proper storage and use of pesticides under tropical conditions.

Although the people she interviewed expressed views and opinions favorably disposed toward a national level consultation approach for identifying crop protection priorities, Matteson did not feel this method would be useful and recommended, instead, the following four means of priority identification:

1) farming systems research programs - she believed that practical and acceptable technological priorities, including those for crop protection, could be readily identified by research staff in these projects,

2) national crop pest control workshops - she felt that the advantage of this approach was that it would be thorough, it would represent a valuable learning opportunity and discussion forum, and it could result in increased effectiveness and coherence of national programs,

3) regional pest management specialist - she believed that this individual could determine crop protection support priorities and/or be responsible for holding a series of national workshops, and

4) regional pesticide management workshops - the original purpose of her trip, she considered that pesticide management was an excellent topic for the presentation of one or two regional workshops utilizing CICP'S tentative workshop agenda as the basis for workshop planning.

PROGRAM EVALUATION OR DESIGN

KENYA

NIGERIA

CAMEROON

Triennial Review of the International Center of Insect Physiology and Ecology, Nairobi, Kenya, Mar. 26-April 9, 1983

The Sponsoring Group for the International Center of Insect Physiology and Ecology (ICIPE) requested this review of ICIPE's management and research programs to assist it in its support of the Center. Even though ICIPE had been the subject of a number of other reviews in the past few years, this was its first triennial review. There were seven members on the review team, each having been chosen to give a wide range of scientific and managerial experience. ICIPE was asked to provide one of these individuals and selected Fowden G. Maxwell, chairman of the Department of Entomology at Texas A&M University.

The objective of the review was to assess the content, quality and potential impact of the research program of ICIPE and to examine whether the work being funded is being done according to the policies of the Center's Governing Board and to the high levels of scientific excellence expected of such an institute. In the conduct of this review, the team was instructed to pay particular attention to the following issues: ICIPE's mandate and its relevance to the future work of the center; the efficiency and quality of its management; the objectives of the research programs and their relevance to the problems of agriculture; the quality of the research; the adequacy and stability of funding; cooperation with national and international programs, and the potential impact and usefulness of the Center's activities.

During the course of the review, the team examined all aspects of the Center's management and operations, including a review and analysis of the circumstances and background regarding its founding and esta-

blishment. The existing management structure of the Center and its operation was critically examined and some of the problems encountered were discussed in some detail. Special attention was paid to the financial crisis that occurred in the Center's operation during the period 1979-1981. A thorough analysis of the events and contributing factors which led to ICIPE's financial problems was made and, as a result, the team concluded that a substantial change in the Center's management processes and operations was required to ensure its sound financial condition and the future extension of its research. In order to produce this change, the team made a series of recommendations for improving ICIPE's performance in the following areas: strategic planning, policy formulation and review, management control processes, and capital budgeting. Many of the specific recommendations made to promote or produce these basic changes in the Center's management reflected the team's conviction that there was a necessity for the Governing Board to have a greater capacity for, and role in, reviewing key decisions; that a shift in the director of ICIPE's centralized management style toward an upgrading of the capabilities of some key staff and improvement of control systems was desirable; and that a much greater participation of senior scientists in planning research policy and programs was required.

The review of the Center's goal-oriented core research programs and research units was conducted through visits to ICIPE's laboratories and field research sites, formal presentations of their programs by the scientists involved, and an examination of the extensive documentation provided the team. The major research programs of ICIPE are on crop borers, insect pathology and pest management, bases of plant resistance to insects, livestock ticks, tsetse flies, and medical vectors. Re-

search support units are on sensory physiology, chemistry and bioassay, and histology and fine structure. Nearly a third of the team's report was devoted to their evaluation and analysis of ICIPE's programs and research units. The team's findings and conclusions for each program and unit was presented according to the same general outline or scheme, i.e.:

- 1) Background and objectives of the program or unit
- 2) Description of current work
- 3) Management
- 4) Strengths and limitations
- 5) Future plans
- 6) Potential users of new technology and knowledge
- 7) Recommendations

The work of the Center's technical and support units, such as the computer services and biostatistics, and the insect and animal breeding unit, were also subjected to review as were training, communications and library services. A separate chapter in their report included commentary on the desirability of having ICIPE undertake greater cooperation with international organizations and research centers and contained the recommendation that ICIPE make an effort to link to other national integrated pest management programs and, particularly, the large FAO-sponsored programs in the Sahel area of Africa and the USAID-sponsored Plant Protection programs in Tanzania.

It would not be appropriate or particularly practical to attempt to present all of the review team's numerous recommendations and suggestions; however, a listing of the more important recommendations will reveal the scope and extent of their analysis of the Center's management

and operation. These recommendations state:

- 1) that the composition of the members of the Governing Board be modified to include additional professional skills in finance and management,
- 2) that an Assistant Director-Administration be appointed,
- 3) that consideration be given to consolidating the research programs on crop borers and the bases of plant resistance,
- 4) that plant breeding work be limited to a study of the genetics of resistance,
- 5) that cooperation with the international centers and programs continue to be strengthened,
- 6) that travel funds for scientists to travel abroad periodically for short-term study, meetings, etc. be made available,
- 7) that the program on livestock ticks receive more support for field work,
- 8) that the overall program on tsetse flies strike a balance between basic research and practical application,
- 9) that morphological work on sense organs concentrate more on functional, rather than descriptive, aspects,
- 10) that the natural product chemistry program be confined to a few areas where it is not competing with organizations that have far greater resources,
- 11) that ICIPE take a major decision about the future role and functions of the histology and fine structure unit,
- 12) that some investment in minicomputers at strategic locations be made as soon as possible,

13) that the Center develop a five year plan for its training programs and develop a closer collaboration with the University of Nairobi in areas of mutual interest in regard to this program,

14) that ICIPE obtain an independent estimate of the funds needed to complete Mbita Point Field Station,

15) that no further investment take place at any of the other field stations until the Governing Board has received a detailed report on the potential usefulness of these sites to the ICIPE program, and

16) that stable funding for ICIPE be given a high priority by the Sponsoring Group.

Regional Development Project for Cassava Mealybug and Green Spider Mite Biological Control in Africa, May 4-21, 1983

In October 1982, the Biological Control Unit of the International Institute of Tropical Agriculture (IITA) in Nigeria submitted a proposal to several international donor agencies, including USAID, soliciting funds for a Regional Development Project designed to achieve biological control of the two major introduced pests of cassava in Africa - the cassava mealybug, Phenacoccus manihoti Matile - Ferrero, and the cassava green spider mite, Mononychellus tanajoa (Bondar). To assist them in evaluating the IITA research proposal, USAID asked CACP to send two consultants to Africa to conduct an on-site review of the mealybug and spider mite problems on cassava. The individuals selected for this assignment were biological control specialists John W. Beardsley, University of Hawaii, and Kenneth S. Hagen, University of California, Berkeley.

Upon arrival in Nigeria, the two men held discussions on the proposed project with entomologists and plant breeders assigned to IITA's Root and Tuber Improvement Program. They also met with other IITA officials and discussed the international implications of the proposed project and how it relates to the overall program priorities of IITA. While at IITA, they visited experimental plots where natural enemies of the cassava mealybug had been introduced from South America in 1981, an insectary facility where small numbers of natural enemies were being produced, and they also inspected a larger insectary facility under construction which was to be used in pilot studies to develop technology for use in the large mass rearing facility proposed for the project.

The two men also visited commercial cassava plantations and private plantings, examining fields that had formerly been heavily infested with cassava mealybug and where IITA entomologists had liberated natural enemies during November 1982. They observed pest populations in these fields and collected their associated natural enemies. Based on their observations, they suggested that neither of the two imported parasite species, alone or in combination, is likely to provide adequate biological control of the cassava mealybug and that additional natural enemies definitely are needed.

Beardsley and Hagen also observed the research that was being performed to find resistant varieties to these two pests, and this work appeared to strengthen their conviction that the development of host plant resistance to cassava mealybug and the green spider mite can be used in conjunction with classical biological control by imported natural enemies to achieve effective economic control of these pests.

In the IITA proposal, a very large scale effort, involving mechanized mass rearing facilities and widespread distribution by aircraft, was advanced to achieve rapid control of the cassava mealybug and green spider mite over the entire cassava belt of Africa. The effort was to concentrate first on Cassava mealybug natural enemies since it was the more serious pest. Insects produced in the facility would be made available to other countries requesting them, but the proposal did not favor the establishment of large satellite regional insectaries because of the lack of trained personnel and lack of program continuity. The magnitude of the proposed biological control program included additional capital improvements, such as housing for staff and trainees and greater electrical generating capacity at IITA. These improvements account for a large fraction of the overall budget and were intended to furnish the nucleus of a permanent biological control center for Africa.

After reviewing the proposal, the two consultants expressed some misgivings about the need and practicality of the proposed mechanical automated mass production insectary. They felt that problems of maintenance, power, contamination and the like would arise in such a facility, and they were concerned that the undertaking would fail. They also questioned the necessity and practicality of the proposed scheme of aerial distribution of the natural enemies produced by the insectary. Apparently, many of the technical details of aerial distribution had yet to be designed and tested, and they expressed the opinion that the method might not prove practical. Alternatively, they suggested that distribution by commercial airlines, or leased small aircraft, to major population centers, followed by ground distribution and liberation in infested areas might be more practical.

Beardsley and Hagen also visited the Central African Republic and Senegal to discuss the proposed IITA regional program for biological control of cassava mealybug with country officials and to view pest infestation in the field. From their observations of mealybug populations in cassava fields under native cultivation, they stated that the cassava mealybug problem appeared to be more serious in the Bangui area of the Central African Republic than in any other part of Africa they visited. The situation in Senegal was also very serious, and they saw many fields with extensive plant damage in the form of defoliation and shoot death. They did not find any green spider mites in any of the fields examined. While in Senegal, they discussed the possibility of establishing an insectary facility there for the propagation of cassava mealybug natural enemies.

In light of the stated objectives of the proposed project, and after viewing the problem in the field and talking with many people concerned with crop protection in Africa, the two consultants offered the following conclusions and recommendations:

(1) The two pests, particularly the cassava mealybug, are extremely serious and, if not controlled, will seriously reduce food production in tropical Africa,

(2) Continued foreign exploration to find additional natural enemies of both pests should receive strong support throughout the life of the proposed project,

(3) A large central insectary facility to mass produce and distribute these natural enemies is essential to the project's success and the most suitable locality for such a facility appears to be at IITA in Nigeria,

(4) The permanent biological control facility should include an introduction center equipped to receive and process shipments of beneficial organisms from overseas. They were not convinced of the practicality of the very large mechanized insectary facility included in the IITA proposal and suggested that alternatives to this should be explored,

(5) Regional satellite biological control insectary facilities for the rearing and local distribution of natural enemies should be established at Dakar, Senegal; Yaounde, Cameroon; M'vuazi, Zaire and Dar es Salaam, Tanzania,

(6) The proposal to utilize aircraft as the primary means of field distribution for the natural enemies of these two pests should be very carefully reviewed before it is implemented. Although feasible under some circumstances, they believed that in many areas ground transportation and natural spread would provide a more efficient and economical means of dispersing these natural enemies,

(7) The training of African entomologists and research assistants in the philosophy and technology of biological control under this project deserved the strongest possible support and USAID should provide scholarship support for the undergraduate and graduate training of promising African students, and

(8) The intent to establish a permanent biological control capability for tropical Africa, in connection with IITA and the regional/national insectary facilities to be established under this project, was one of the most supportable aspects of the overall proposal.

Sahel Regional Food Crop Protection Project in Cameroon, May 8-24, 1983

CICP Consultants Edward H. Glass and James Goodwin were sent to the United Republic of the Cameroon for three weeks in May in response to an USAID request for assistance in the evaluation of the Regional Food Crop Protection (RFCP) Project as it pertained to its implementation in the Cameroon. As part of their assignment, they were asked to design a work plan for a national Food Crop Protection Project; prepare a plan of action which would lead to the development of appropriate integrated pest management for various food crops important to the country; determine whether or not necessary government resources will be available for this program; develop a plan for extending integrated pest management to farmers; and examine and define the role of the Centre Regionale de Formation Phytosanitaire de Yaounde (CREFPHY) as a training center.

As a necessary prerequisite for carrying out their assignment, the two men reviewed the plans for the original project and found that there were a number of fundamental problems and deficiencies in its design that hindered the achievement of its objectives. Among the more important problems they identified were:

- 1) the lack of a research component in the project for the Cameroon,
- 2) an incorrect assumption of the availability of integrated pest management packages from other countries involved in the project. (In fact, they stated that, according to their information, the other countries were even less capable of developing IPM under this project than the Cameroon),

3) inadequate recognition of the lack of Cameroonian scientists with advanced training in crop protection and, therefore, insufficient provision for training crop protection scientists in the project,

4) inadequate provision for linkages between the training and extension components of the project and between research efforts in Cameroon and other countries, and

5) a diffusion of efforts and lack of continuity in program implementation due to the fact the focus and scope of the project had been drawn too broad in relation to the resources made available from USAID and the government of the Cameroon.

An additional deficiency which the two men felt had plagued the project from the beginning was the ill-defined administrative structure and unclear lines of authority, a situation they believed did not provide for a cohesive, smoothly functioning and efficient project. They proceeded to examine the country's existing administrative infrastructure as it related both to crop protection in general and those components which are involved in the development and implementation of integrated pest management programs and then attempted to identify factors which would bring the various elements together into a truly functional unit that would be capable of developing integrated pest management strategies and extending these to the individual farmers. Their examination covered a great many aspects of training, personnel, coordination/communication, equipment, and technical assistance and resulted in the following assessment of these components:

1) Training - Glass and Goodwin felt that training was needed at all levels and emphasized that in-country training of all extension workers and food crop protection personnel in the basics of crop protec-

tion and integrated pest management was essential. At a minimum, training of technical personnel abroad should include advanced degree training toward a master's or doctorate's degree for two individuals each in the fields of entomology, plant pathology and weed science. They stated further that training of technical support personnel to assist researchers was also needed.

2) Personnel - They considered that a substantial increase was needed in the number of Cameroonian personnel involved in crop protection and declared that this need was most apparent at the extension level.

3) Improved Communication/Coordination - Glass and Goo'win felt that the government needed to take whatever actions were necessary to develop lines of communication and coordination among the research agency, the crop protection service, the training center (CREFPHY), and extension personnel.

4) Equipment - They felt that the major need was for transportation, especially at the extension level, because the distance between farms and lack of roads virtually prevented contact between farmers and extensionists.

5) Technical Assistance - The two men stated that, at the very minimum, this should include provision of expatriate equivalents to those Cameroonians selected for graduate training in other countries.

As a result of their conversations with a great many persons in the country, an examination of various reports dealing with the RFCP and other projects and their travel to the West, Northwest, Littoral, Center South and North Provinces, the two consultants concluded that Phase II of the RFCP Project, which was scheduled to terminate in September,

1984, was at a critical stage in terms of its future, especially in the Cameroon. In formulating their opinions and recommendations about the future of this project, they considered several options - varying from a termination of the RFCP Project as quickly as possible in terms of existing agreements to a continuation of the project as currently designed, but eliminating the regional aspects (except for CREFPHY) to a modification of the project to make it preparatory to a new, expanded bilateral project to be designed over a period of the next 16 months. After due consideration of the advantages and disadvantages of the various options proposed, they recommended that the last named option above be followed, provided that the project is redesigned to make it more effective in bringing IPM to the farmers and that it promote an orderly coordination of crop protection activities among involved ministries and agencies in developing and implementing IPM tactics and strategies.

In their report, the two men stressed that there were several important needs that must be addressed in order to create an adequate crop protection capability in the Cameroon. These were: (1) additional trained scientists, (2) establishment of crop protection research programs, (3) reorientation of the Crop Protection Service and Extension to a balanced IPM approach to food crop protection, (4) building and equipping laboratories and satellite field stations, and (5) in-country academic training capability in the crop protection sciences. Although they had had a very intensive overview of Cameroon agriculture and its pest problems, Glass and Goodwin believed that it had been too superficial and that there had been too little time to digest all that they had seen, heard, or read to prepare a definitive projection beyond the next

two or three years. Their final recommendation was that preliminary planning be initiated over the next two years for a new crop protection project which can follow immediately after the termination of the present project, and they suggested that this project be somewhat like the Philippine Crop Protection Project begun in the late 1970's, albeit adapted to the Cameroon situation.

TRAINING ACTIVITIES

SHORT COURSE ON INTEGRATED PEST MANAGEMENT

TONGA

PESTICIDE MANAGEMENT SEMINAR/WORKSHOPS

BOLIVIA

PEST MANAGEMENT WORKSHOP

BRAZIL

Sub-Regional Training Course on Methods of Controlling Diseases
Insects, and Other Pests of Plants in the South Pacific, Govern-
ment Experimental Farm, Vaini, Tonga, October 4-20, 1982

The modern facilities of the plant protection complex at the Vaini Government Farm provided the setting for this short course presented for plant protection officers, extension personnel, and research technicians of the island nations of the South Pacific by CACP, the U.S. Agency for International Development and the German Agency for Technical Cooperation (GTZ), with the cooperation of the Tonga Ministry of Agriculture, Fisheries, and Forests and the South Pacific Commission. Postponed from May 1982 because of the effects of a devastating cyclone which hit the island of Tongatapu on March 3rd, the course was attended by twenty-eight individuals from fifteen island countries of the region. Lecturers were drawn from the Tonga-German Plant Protection Project, other GTZ projects in Central America and Western Samoa, the International Rice Research Institute (IRRI), the Universities of Guam and Hawaii, the United States, scientific and industrial research organizations in Australia and New Zealand, and various institutions of other island countries of the South Pacific region.

The objective of the course was to assist the trainees to identify the diseases, insects and other pest problems in their countries, assess the losses caused by the pests and choose the appropriate measures for their control. The course included formal lectures, panel discussions, evening workshops on selected topics and a series of supplementary practical exercises carried out in the field and laboratory. In the first two days of the course, trainees were provided with an overview of

plant protection practices in the South Pacific as well as a review of the major insect pests, diseases and weed problems of crops in the South Pacific region. Subsequent sessions were devoted to a consideration of the fundamentals and practical aspects of various pest control tactics, such as cultural control, use of disease resistant varieties, biological control, and the use of pheromones, hormones and genetic methods of insect control. Case histories of the biological control of the giant African snail and the integrated control of the coconut rhinoceros beetle were highlighted while the principles and techniques of chemical control and its use in integrated pest management were also given emphasis. Among other topics discussed in the lectures were the influence of pests on traditional and cash crops of the region and the concept of economic injury levels.

At a field demonstration site on the Vaini Experimental Farm, course participants were taught the procedures used to determine the economic feasibility of pesticide use on crops and to establish when and where their use is really justified. Participants were also given practical experience in the correct use of pesticides during a practical field exercise in which the basic steps for their correct use, including safety procedures, were reviewed. For this exercise, the instructor demonstrated the procedures typically used by Tongan farmers for calibrating pesticide sprayers and showed how to calculate the proper pesticide and water mixture for use in the sprayer. Other field exercises and evening workshops were designed to determine how well the participants had grasped the IPM concept and its application and required the trainees to assess the pest problems and needs for IPM implementation in cabbage, capsicum, peanut and paper mulberry and to identify the re-

quirements for developing integrated pest management programs for coconut, taro, banana and tomato. On the final day of the course, all the participants entered into an open discussion of the future of integrated pest management in the island countries of the South Pacific. As a result of this discussion, a number of recommendations for training, research and coordination of information on integrated pest management were developed.

Following the termination of this course, the same Government Farm facilities were used to present a five-day training program (October 25-29) in plant protection specifically for U.S. Peace Corps Volunteers serving in the South Pacific region. The objectives of this course, which was attended by seventeen Volunteers from the islands of Tonga, Fiji, Western Samoa and Papua New Guinea, were to:

- 1) review the concepts, techniques and application of plant protection, with emphasis on the use of integrated pest management,
- 2) assist the trainees in locating sources of information and services for identifying diseases, insects and other pest problems in the South Pacific, assessing the losses caused by these pests, and deciding on appropriate control procedures,
- 3) review the requirements and procedures for pesticide use in USAID financed projects carried out by the Peace Corps and private organizations, and
- 4) examine the economic, social and political factors affecting the development and implementation of plant protection programs.

Seminar/Workshop on the Use, Management and Application of Pesticides
in Agriculture, Cochabamba, Bolivia, February 21-25, 1983

This five-day seminar/workshop on the use and management of pesticides was held at the Facultad de Biología, Universidad Mayor de San Simón in Cochabamba, Bolivia under the sponsorship of CICP, the Ministerio de Asuntos Campesinos y Agropecuarios (MACA) and the PL-480 Title III Project in Plant Protection and Quarantine. The Universidad Mayor de San Simón (UMSS), the Ministerio de Salud and the Instituto Nacional de Salud Ocupacional (INSO) also cooperated in the presentation of this event. As in previous seminar/workshops, the purpose of this conference was to give the participants a greater knowledge and understanding of the major problems associated with pesticide use, i.e. human poisonings, pest resistance and environmental contamination, and also to acquaint them with the basic concepts of sound pest management and the technology that is required for the safe, efficient and economic use and handling of pesticides.

Slightly more than eighty persons registered for the seminar with nearly half of these representing either the Ministry of Agriculture and Rural Affairs or the host university. Other institutions which sent representatives to the seminar included: Instituto Boliviano de Tecnología Agropecuaria (IBTA), Centro de Investigación Agrícola Tropical (CIAT), Corporaciones de Desarrollo from the five departments of Santa Cruz, La Paz, Cochabamba, Tarija and Chuquisaca, the Instituto Nacional de Salud Ocupacional and several research centers and agricultural experiment stations. In addition, there were also participants from several private organizations.

Sixteen Bolivian agricultural and health professionals participated in the seminar as speakers to provide background information on the current status of pesticide use and control programs for pests of important crops in Bolivia. The subjects of their talks included the following: control of malaria in Bolivia, residue problems in human health, control of the primary vector of Chagas' disease (Triatoma infestans), registration and labelling of pesticides recommended for Latin America and Caribbean countries, legislation on the commercialization of pesticides in Bolivia, and pesticide use in control programs for potato, sugar cane, cotton and stored products pests. Seven subject matter specialists from the United States also attended and presented talks on such topics as pesticide chemistry and metabolism, medical aspects of pesticide poisoning, pesticide formulation and application, resistance to pesticides, integrated pest control, pesticide legislation and registration and agromedical approaches to pesticide management.

In contrast to earlier seminar/workshops in this series which scheduled two days for meetings of the workshop groups, the latter groups in Cochabamba met for only a few hours in the afternoon on the final day of the program. Despite this limited time, however, the discussions in the groups relating to the handling, use and management of pesticides and to specific problems in pest management were quite spirited and productive.

Top level changes in the personnel in MACA and the Universidad Mayor de San Simon, together with economic difficulties, led to some last minute changes in the program, the most significant of which were the cancellation of the scheduled demonstration of pesticide application equipment and a workshop on pest management. These changes notwith-

standing, comments and responses from the Bolivian participants and U.S. consultants indicated that the seminar/workshop was generally successful in attaining its principal objective of heightening the participants' awareness of the potential risks and benefits of pesticide use and increasing their understanding of integrated pest management principles and practices.

International Workshop in Integrated Pest Control for Grain Legumes,
Goiania, Brazil, April 3-9, 1983

Presentation of this grain legume workshop was the culmination of an idea advanced in 1980 by the International Institute for Tropical Agriculture (IITA) and the Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA). Subsequently, other organizations became interested in the concept and assisted in the planning and organization of the workshop. The eventual sponsors of this event, in addition to IITA and EMBRAPA, were USAID, CICP, FAO and INTSOY. The objective of the workshop was to identify the needs for research, training, and cooperation for the development and application of integrated pest management programs for grain legumes at the farmer's level.

There were sixty three participants from nineteen countries at the workshop. The majority of countries were represented by only one individual, but Brazil had 21 participants and the United States had twelve. Only three countries in Latin America sent participants whereas there were individuals from ten countries in Africa and five countries in Asia. The workshop was held in the new auditorium facilities of the Centro Nacional de Pesquisa de Arroz e Feijao (CNPAF) in Goiania. A reduction in expected sponsor support affected the scope of the workshop

and a consideration of work on chickpeas and pigeon peas had to be dropped from the program. The crops actually treated were soybeans, cowpeas/mungbeans, and Phaseolus.

The workshop was organized into morning sessions, wherein 3-5 speakers presented a conference on a common topic, and afternoon sessions in which the participants met in working groups to discuss the subjects presented earlier. The chief role of the morning speakers was to set the theme and present a broad overview of a topic dealing with progress in the various aspects of integrated pest management implementation for grain legumes. These talks provided the basis for the daily discussions within the working groups. Each afternoon, participants divided themselves into three working groups of roughly equal size by crop (cowpea/mungbeans, soybeans, and beans) for an in-depth discussion of areas covered in the morning session. Each working group had a coordinator who organized activities, apportioned writing and discussion-leading responsibilities within the groups and assembled, edited and presented the working group's final crop report at the conclusion of the meeting.

The various members of each group assigned to lead the discussions were also asked to summarize these discussions in writing. In order to provide feedback between the groups, the summaries of the previous afternoon's discussions were presented to the entire workshop at the start of each morning's session. The written daily summaries were used by the coordinators to prepare the crop report that was to be presented on the last day of the workshop. These reports were to describe priority avenues of research for the development of integrated pest management systems for the crops considered.

According to the workshop organizers, the working group/discussion format was reasonably successful. It appeared to take awhile for many of the participants to grasp the purpose of the sessions and how participatory, informal, practical and imaginative they needed to be. In their evaluation of the workshop, some of the participants said they could have used more explicitly written guidelines which explained the planned activities for the working groups. They also stated that it would have been helpful if speakers had been asked to prepare a list of questions for the afternoon discussion on their topics.

The final formal discussion of the workshop was devoted to a consideration of the establishment of an international network for the exchange of information on grain legume protection. Participants from several research institutions provided brief descriptions of the information capabilities within those institutions and emphasized the need to strengthen and intensify the exchange of information among the world centers involved in grain legume research. As a result of their discussion, the participants recommended that a meeting of information specialists should be convened to further the idea of this information network, and they suggested that the capabilities of the Soybean Insect Research Information Center (SIRIC) be used as a prototype for the potential development of this network. It was also recommended that the next grain legume workshop should be held in three years.

The week following the workshop, twelve participants took part in a field trip to learn more about grain legume pest management research in Brazil. They visited research stations in Teresina, Piaui State; Fortaleza, Ceara State; Recife, Pernambuco State, and Petrolina, Pernambuco

State and observed field and greenhouse experiments on crop loss assessment and resistance screening for pests of cowpeas.

REGIONAL PEST MANAGEMENT SPECIALIST ACTIVITIES

TECHNICAL ASSISTANCE

VEGETABLE RESEARCH (GUATEMALA)

VEGETABLE PRODUCTION (PANAMA)

REGIONAL IPM PROJECT

Regional Pest Management Specialist Activities
in Central America and Panama

The Regional Pest Management Specialist (RPMS) position in Central America was created in late 1979 as a result of a cooperative agreement negotiated between CICEF and USAID's Bureau for Latin America and the Caribbean. Since its establishment, the RPMS position has been occupied by plant pathologist, Eduardo E. Trujillo, of the University of Hawaii. Dr. Trujillo obtained a two year administrative leave of absence from his university to assume the duties of this position and arrived on post in Guatemala in January 1980, assigned to USAID's Regional Office for Central American Programs (ROCAP). His basic responsibility was to advise and assist ministry officials and plant protection workers in El Salvador, Guatemala, Honduras, Nicaragua, Costa Rica and Panama in the development and implementation of pest management and crop protection programs. After carrying out his assignment with considerable initiative, professional competence, characteristic independence and a high degree of dedication and skill, Trujillo, in September, 1981 was asked to continue in the position for another year.

During his tenure as Regional Pest Management Specialist, Dr. Trujillo demonstrated that a single experienced crop protection specialist could have considerable influence on the policies, programs and operations of national and regional institutions, thereby supporting and reinforcing the opinion of those who believed in the promise, usefulness and effectiveness of the RPMS concept. His extended tour of duty in Central America completed, Trujillo returned to Hawaii in August 1982. In appreciation of his efforts to improve crop protection practices in

the region, particularly on behalf of the farmers and agricultural institutions in Guatemala, the Guatemalan Ministry of Agriculture presented him with a commemorative plaque in July 1981.

Before turning to a discussion of the person who replaced him, it may be worthwhile and instructive to briefly present a summary of Dr. Trujillo's more significant accomplishments during his nearly three years residence in the Central American region. As Regional Pest Management Specialist, Dr. Trujillo functioned somewhat similarly to a cooperative extension service advisor for the region assisting personnel of the USAID Missions, the National Departments of Plant Protection, and other national and regional institutions in pest management and pesticide use related to plant, animal and human health. In this capacity, his ideas and recommendations sometimes found their way into the development, design and implementation of institutional programs that were important to the region, but perhaps his greatest impact on agricultural programs was through his daily contact and association with USAID Mission personnel who were responsible for implementing programs in agricultural development involving crop protection activities.

As an example of his efforts to provide supervision and direction in establishing priorities in crop protection, the RPMS suggested a regional effort in coffee breeding and selection, coupled with tissue culture techniques, to rapidly multiply genetic material of proven resistance and desirable commercial characteristics to cope with coffee rust in the region. Efforts to introduce insect predators and parasites of the African coffee berry borer were also suggested, and these recommendations were incorporated in the ROCAP Project Paper on the Regional Coffee Pest Control Project (PROMECAFE).

An important RPMS activity involved the preparation of initial environmental examinations and environmental assessments for bilateral or regional projects requesting the procurement and use of pesticides in USAID-sponsored projects. The preparation of these assessments is mandated by USAID regulations (CFR 216 - Environmental Procedures), and Trujillo was asked to assess pesticide use in USAID projects being conducted in Panama, Honduras, Guatemala and El Salvador. As a result of these assessments, the RPMS was able to recommend and suggest direct avenues of action intended to minimize environmental pollution because of pesticide use in these projects.

Other important duties of the RPMS included the provision of technical assistance regarding site and crop specific pest management and crop protection activities. For example, he contributed his expertise to the control of a tobacco blue mold epidemic in Honduras. This devastating epidemic destroyed most of Honduras' 1980 crop of cigar wrapping Havana tobacco varieties, causing more than one million dollars damage and affecting more than 2,000 hectares. The control method he recommended for this disease was based on work he had done previously in Hawaii. He also was well situated to recommend actions and suggest appropriate consultants needed to solve a specific crop protection problem. In this latter regard, he was responsible for coordinating the visit to Guatemala of a virologist from Cornell University who made an inspection and review of a mosaic virus disease on Cardamom. As a result of his survey and recommendations, this consultant was given a grant by the Cardamom Association of Guatemala to purify the virus and develop rapid techniques for its detection, an achievement which helped to impede the spread of this disease within the country.

The RPMS was also invited to participate in two CICIP-sponsored short courses on integrated pest management presented in Tapachula, Mexico and Antigua, Guatemala, respectively. In addition, he planned and organized four workshops in plant disease diagnosis for personnel of the National Departments of Plant Protection in the region, as follows: (1) a Nematology Workshop held in Cerro Punta, Panama in May, 1981, (2) a Plant Bacteriology Workshop presented in Antigua, Guatemala in July, 1981, (3) a Plant Mycology Workshop held in Zamorano, Honduras in December, 1981, and (4) a Virology Workshop that took place in Weslaco, Texas in April, 1982, for which he served as lecturer, training officer, controller, scientific translator and liaison. The workshops were intended to create a small nucleus of well-trained pest management specialists within the Departments of Plant Protection of the region, as many of the same individuals participated in all four courses. The workshops were ten days in duration and consisted of intensive practical and theoretical training in specialized aspects of pest management. They were praised by many of the participants for their organization, content, quality, usefulness and applicability to the trainee's work.

Trujillo's last major activity was to conduct a survey of national and regional organizations and institutions to collect data on availability of trained personnel, support available, research in progress and major pest problems of the region. He undertook this survey in the company of a CICIP entomologist consultant and together, they visited Costa Rica, Guatemala, Honduras and Panama to obtain the information noted above. A report discussing the results of their review was issued in 1982.

Trujillo also prepared a report summarizing his activities and experiences as Regional Pest Management Specialist; in this final report, he expressed his ideas and opinion on the qualities, skills and attributes an individual would need to possess in order to be an effective RPMS. He also discussed the pros and cons of having this individual be hired as an USAID employee or under contract.

The New RPMS

The individual selected to continue the work of the RPMS is entomologist, Angel A. Chiri. At the time he accepted this position, he was employed as a postdoctoral scientist at the University of California in Riverside where he was participating in a study to determine the critical period of cotton plant susceptibility to the attack of a species of mirid plant bug. This investigation also studied the role of wild host plants in the foothills of the Sierra Nevada Mountains as a reservoir for populations of this pest which then disperse into commercial crops on the floor of the San Joaquin Valley. Previously, he had obtained his doctorate from this same university in 1980, having conducted a behavioral study of four hymenopterous parasites of the cotton pink bollworm and their responses to host-seeking chemicals for his thesis research. Dr. Chiri arrived in Guatemala in September 1982 to begin his assignment.

Although the broad responsibilities of the new RPMS remain essentially the same as those of his predecessor, a change of emphasis in the amount of time devoted to specific duties was required because of a decision by ROCAP to initiate and fund a regional project on integrated pest management whose purpose was to improve regional and national

capabilities in environmentally sound pest management technologies. The project was also to develop an integrated regional strategy for institutionalizing programs on pest management. Thus, the new RPMS was expected to expend a considerable amount of time and effort to bring together pest-related information necessary for the planning of a regionally integrated program and to establish vital lines of communication and collaboration between both public and private institutions and individuals concerned with pest-related problems.

For the sake of his role of providing guidance and coordinating efforts for the development and implementation of this project, and to maintain program continuity, it was essential for the new specialist to renew and continue earlier contacts and relationships established by the previous RPMS. Consequently, shortly after his arrival in Guatemala, Dr. Chiri scheduled a trip to El Salvador, Costa Rica, Panama and Honduras to become personally familiar with government officials and technical personnel of the principal plant protection organizations in the region and to enlist their cooperation and support for the proposed regional IPM project. Another purpose for his trip was to further assess and identify local crop protection needs, research and extension capabilities, counterpart organizations, and key people with the background and capabilities necessary to actively pursue and promote the objectives of the integrated pest management project. The following account reviews two examples of technical support and assistance in which Dr. Chiri was a participant and also discusses his participation in preliminary discussions that formulated the objectives and plan of operation of the proposed regional IPM project.

(1) AGMIP research program on vegetables in the Almolonga Valley, Guatemala - Toward the latter part of 1982, Regional Pest Management Specialist, A. A. Chiri, received a request from representatives of the Asociación Guatemalteca de Manejo Integrado de Plagas (AGMIP) for assistance in the design of a series of experiments intended as a basis for the development of an integrated pest management program on vegetables grown in the Almolonga Valley in the Department of Quezaltenango. These experimental trials were an integral part of a proposal for an integrated pest management project which had been prepared by the Instituto de Nutrición de Centro América y Panamá (INCAP) and Proyecto de Desarrollo Rural Integrado and submitted to USAID in March 1982 for possible funding. The project, which was to be implemented by AGMIP, INCAP, Laboratorio Unificado de Control de Alimentos y Medicamentos (LUCAM), Instituto de Ciencia y Tecnología Agrícolas (ICTA) and the U.S. Peace Corps, involved four distinct phases, the first of which had already been completed:

- 1) detection of the problem,
- 2) collection of baseline data on pesticide residues through environmental and human monitoring,
- 3) research on integrated pest management, and
- 4) transfer of technology.

In support of AGMIP's request, CICP arranged to send entomologist Carl Barfield, University of Florida, to Guatemala from December 5-11, 1982 for the purpose of reviewing the proposed project and preparing an experimental design for the field studies. Accompanied by the RPMS, Barfield visited the Almolonga Valley to meet with growers, become more familiar with actual pest problems and observe in detail the layout of

small parcels used by local farmers. The two men also met with AGMIP technical personnel and ICTA extensionists and researchers who had worked in the Almolonga Valley for several years to obtain information on the growers' current crop production and protection practices, use of chemical pesticides, and the role of local irrigation practices on the incidence of disease in vegetables.

From their observations, insect pests did not appear to be a problem in the Valley. Most of the pest problems they saw and all of the problems discussed by growers were due to diseases. In the control of these diseases, it was quite obvious to them that the growers were overusing pesticides as, for example, some growers would apply fungicides every two days to onions, even in the total absence of fungal symptoms. In order to convince these growers to adopt integrated pest control methods rather than depend completely on chemical pesticides, Barfield suggested a research program which would have the following four objectives:

- 1) To observe celery (which had been agreed upon as an initial target crop) growth, damage and yield under traditional and select non-traditional agricultural practices,
- 2) To observe effects of crop rotation on the incidence of pests and diseases,
- 3) To win the confidence of Almolonga Valley growers, and
- 4) To pictorially represent (2 x 2 color slides or prints) target crop growth, incidence of pests and final produce in each parcel used.

To conduct this research, he suggested that AGMIP would need to lease up to 15 parcels of land. These parcels would be subjected to nine treatments, each replicated three times, in an experimental design

which would permit comparison to be made of the effects of irrigation and pesticide use under conditions of traditional, modified or no use. Barfield felt that this project could be conducted in a practical fashion with available personnel and resources and that the chosen design would allow the generation of hypotheses on what were the important factors creating pest problems in the Valley. Furthermore, he considered that the results from the first year's data would allow the design of experimentation in the second year which would focus more on specific problems.

(2) Vegetable production in the Chiriquí Province, Panamá -

Together with consultant B. Merle Shepard, Clemson University, South Carolina, the RPMS visited Panama from April 4-16, 1983 to conduct a survey of pest management practices on vegetables grown in the Chiriquí Province for the purpose of formulating recommendations for the development of an integrated pest management program. Background information on the important constraints to vegetable production was obtained from technical personnel of the Instituto de Investigación Agropecuaria de Panamá (IDIAP), the Ministerio de Desarrollo Agropecuaria (MIDA), the Banco Nacional de Panamá and the USAID Mission. In order to gain an impression of the relative importance of some of the major pests associated with the crops grown at that time of year, they visited farms in the Volcán - Cerro Punta area and talked with growers. A relatively incomplete list of the major pests on various vegetable crops was compiled, based on the pests they actually observed during their visit, and presented as an appendix to their report.

Shepard and Chiri reported that the most obvious problem associated with pest control methods in the Chiriquí region was excessive use of

pesticides, irrespective of need. Wide spectrum pesticides were applied at frequent intervals, often 12-14 times per season, even though there was no real familiarity with the target pest. They stated that it was evident that growers in the area had received inadequate or no training in the proper selection and use of pesticides and, in general, little regard for the potential hazards of pesticides was shown. The two men also noted a general lack of awareness on the part of growers of the possibilities of the development of resistance in the pest species, and they expressly indicated in their report that information given them by growers led them to suspect that the potato tuberworm was developing resistance to the more commonly used insecticides.

In certain areas, where growers allowed crops to remain in the field too long before they were harvested, heavy crop damage by pests was observed. In fact, a major concern among all growers interviewed was the inability to market their crops due to excess production of specific crops during certain times of the year. Consequently, some fields of potatoes and onions might not have been harvested at all and had remained in the field to become loci for the buildup of pests.

Perhaps the most serious shortcoming to current crop protection practices they encountered was the lack of trained personnel in extension and research. Due to the lack of extension personnel, growers had little or no contact with crop protection specialists who could make specific recommendations regarding treatment decisions, use of insecticides or other aspects of pest control and consequently, they usually applied chemicals based on the recommendations of pesticide salesmen or distributors. Little confidence was expressed by growers interviewed in

MIDA and IDIAP crop protection personnel, most of whom were young and very inexperienced.

Based on an appraisal of the situation they found in the Volcán - Cerro Punta area, Shepard and Chiri declared that the first step toward developing a sound integrated pest management program for vegetables would be the acquisition of extension agents adequately trained in crop protection. These agents could be trained by attending short courses designed for this purpose. They suggested that these extension agents, together with research personnel, could conduct a pilot IPM program on vegetables in order to introduce growers to more technologically advanced vegetable production systems.

In order to address the immediate needs of the region, the two men recommended that short term consultants in the areas of plant pathology, entomology, nematology and weed science be contracted to survey the vegetable growing areas during different times of the year and determine the major pests, their relative importance and seasonal abundance. They believed these consultants could play a critical link between extension and research personnel and growers through the transfer of technology, including making pest control recommendations to growers. The consultants could also suggest research activities which could lead to the development of IPM programs.

Shepard and Chiri considered that the development of proper pesticide use patterns, monitoring for pest resistance, and exploring ways in which pest damage could be reduced through cultural techniques and resistant host plants was also of immediate concern. To address these and other issues, they recommended that extensive surveys of pesticide use patterns be conducted and that a pesticide regulatory laboratory for

analyzing pesticide residues be established as well as adequate quarantine facilities and a pest diagnostic laboratory and information center. In conclusion, they expressed their conviction that, with careful planning, IPM programs on vegetables appropriate to Panama's conditions could be developed using the experience gained from other parts of the world.

(3) Regional Project in Integrated Pest Management - CICP consultants Louis A. Falcon, insect pathologist, University of California, Berkeley; Michael E. Irwin, soybean entomologist, INTSOY, University of Illinois; and Katherine Reichelderfer, agricultural economist, ERS, U.S. Department of Agriculture, Washington, D.C., together with the RPMS, assembled in Turrialba, Costa Rica from May 22-26, 1983 to meet with personnel of the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) to discuss the design, concept and implementation of the proposed five year ROCAP/CATIE Regional Project in Integrated Pest Management. The purpose of this project is to strengthen the regional and national institutional capability for crop protection in Central America and Panama and to help establish sound integrated pest management programs aimed at decreasing the deleterious effects caused by pest organisms to the major crop production systems in the region as well as reducing the negative environmental impact of the pesticides used for their control.

The principal objective of this proposed project is to establish and maintain a centralized regional source of technical services and information at CATIE which will be capable of assisting the national and regional institutions with integrated crop protection activities. Other objectives of the project are to develop and analyze a profile of pest

perceptions which could be used as a device for targeting national, bilateral and regional IPM research and educational programs; to create an awareness among national institutions and personnel for the need to determine the general losses caused by major pests and to promote appreciation of the usefulness of this information for providing more appropriate guidelines for control of these pests to farmers; to train directly or provide the means for training a significant number of regional and national technical personnel through the presentation of short courses and seminars at CATIE and selected national level field sites; and to establish an identification and diagnostic service at CATIE, assisted by a network of crop protection extension personnel, which would provide the capacity for positive and timely identification of exotic and native pest organisms.

The project is composed of three major components: technical cooperation, training and research. The technical assistance component involves the organization, storage, retrieval, synthesis, development and dissemination of technical information required to facilitate research, training and technology transfer in integrated pest management. The project will fund long and short-term advisors to constitute the initial staff who will implement these activities. The training program addresses each of the various groups of individuals involved in Central American pest control decision making and is intended to increase the efficiency of crop pest control by improving general knowledge of the technical and socioeconomic implications of alternative pest control approaches. The research component will focus its activities on a few selected pest-crop systems, seeking to identify appropriate IPM practices through the support of collaborative research by interested na-

tional groups, and will promote the integrated pest management philosophy to pest control in these efforts.

The participants at the meeting in Turrialba discussed and reviewed the goals, objectives, justification, specific planned activities, input requirements, expected results and benefits, etc., of this project in some detail, and subsequently formulated a number of modifications in various aspects of the project design and plan of operation. Based on this review, they believed that the project would be able to correct what they considered were the principal impediments to the successful transfer of crop protection technology in the region, namely: (1) the lack of trained personnel in crop pest management, (2) the continual loss or disuse of regionally generated technical information on crop-pest relationships, and (3) the resultant uncoordinated, repetitive research activities. In sum, the participants gave a favorable review to the project and considered that it would complement and support related national and bilateral programs in pest management and that it would establish and maintain close relations with different institutions and concerned groups at the international, regional and national levels.

PESTICIDE RESIDUE ANALYTICAL TRAINING PROGRAM

QUALITY CONTROL PROGRAM

TRAINING ACTIVITIES

MIAMI

TECHNICAL ASSISTANCE

DOMINICA

PARAGUAY

University of Miami Training and Quality Control
Program in Pesticide Residue Analysis

Personnel of the University of Miami's Department of Epidemiology and Public Health in Florida continued to conduct training and technical assistance activities in pesticide management (agromedicine) and analysis of pesticide residues for developing countries under terms of a subcontract agreement with CICP. An important aspect of their activities is the management of a quality control program that was established in 1974 to develop and maintain uniform standards of operation among a network of analytical pesticide residue laboratories in developing countries. Participation in this network is restricted to 45 laboratories to permit effective management of the program. Every few months, participating laboratories receive a sample containing a mixture of pesticides and asked to analyze it using methodology suggested by the University of Miami. Laboratory chemists may use other methods, however, as long as they specify the method used. The chemists are asked not only to identify the pesticides present but also to determine the amount of each chemical present. For the period under review, the director of the program prepared and formulated sample UM-016 and mailed it to all 45 participating laboratories. He also completed a critique and evaluation of the reports received from the laboratories which had analyzed the previous sample, UM-015. This evaluation is sent to responding laboratories in order to help them improve their performance and to allow them to compare their performance with other laboratories in the program. A confidential coding system prevents the identity of individual laboratories from being discovered.

Training Activities

Since 1977, short training courses in pesticide residue analysis have been presented at the facilities of the University of Miami for individuals selected from participating laboratories. These courses provide practical knowledge in sample extraction and clean-up, use of analytical equipment and identification/ quantitation, pesticide safety practices and basic information on the chemistry of herbicides, fungicides and insecticides and their fate in the environment. In 1982, two courses were presented for chemists assigned to pesticide analytical laboratories in Nicaragua, Guatemala and St. Lucia. The dates for the courses were September 12 - October 12 and November 7 - December 16.

In addition to the quality control program and formal training activities, personnel of the Department of Epidemiology and Public Health also provide technical assistance to USAID Missions and institutions in developing countries. During the last week of May, 1983, a chemist from the Miami laboratory obtained ten samples of fruits and vegetables collected from a food market in Roseau, Dominica and blood serum samples collected from 21 agricultural workers and hand-carried them to Florida for analysis. The food products sampled included celery, banana, cabbage, tomatoes, yams and cucumbers and, based on the analytical methods used, did not present any residue problems. The blood samples indicated some chlordane and DDT exposure, but the residues were low compared to values obtained from the U.S. general population. The analysis also indicated that the Dominica workers may have been exposed to dieldrin and/or aldrin. The values of the level of cholinesterase in the blood obtained from several workers were near the

low end of the normal range of values found in U.S. studies, and it was recommended that these workers be monitored closely.

The director of the quality control program, J. Bruce Mann, in response to a request from USAID went to Paraguay from November 2-10, 1982 to visit the laboratory of the Instituto Nacional de Tecnología y Normalización (INTN) to evaluate its equipment and facilities and assess the capability of the personnel to analyze pesticide residues. In his report, Mann noted that the laboratory had the correct type of glassware needed to conduct the analyses for residues of the organochlorine and organophosphate pesticides that were being used in Paraguay, but did not have them in sufficient quantity to analyze more than one or two samples a day. He also observed that some of the equipment in the laboratory, although in working condition, was outmoded and parts for them were no longer available for replacement. The chemist in charge of the laboratory had some knowledge of gas chromatography and pesticide residue analysis but, in Mann's opinion, was in need of additional training before a monitoring program for pesticide residues in food could be established. The other two persons in the laboratory were involved in conducting analyses for heavy metals and aflatoxins and would also require additional training so that they could participate in the monitoring program. In his discussions with the personnel of the laboratory, Mann took the opportunity to review various laboratory procedures and techniques, such as proper handling and storage of standards, use of relative retention charts, handling of column packing materials, theory and operation of an electron capture detector, etc., as these topics were found to be areas in need of improvement. Until such time that the personnel of the INTN laboratory could be trained, Mann recommended that

samples of food from the Mercado de Abasto in Asunción be sent to the University of Miami for analysis of pesticide residues.

The contribution of University of Miami personnel in other CACP activities has been presented in earlier sections of this report, (see discussions of the Seminar/Workshop on the Use, Management and Application of Pesticides in Agriculture in Bolivia and the Evaluation of the IPM Program on Cotton in the Sudan). In order to insure that the methods of analysis for Temik[®] that would be used by the University of Miami in the monitoring program for the Sudan cotton IPM project (cited above) would be comparable to the methods used by the Union Carbide Agriculture Products Company, Inc., Bruce Mann visited that company's development laboratory in North Carolina from September 7-9, 1983 to hold discussions with company officials concerning methodologies and to observe the methods used in their laboratory. In the report on this visit, Mann stated that analysis of urine samples will be used in the Sudan project to measure human exposure to Temik[®]. These samples will also be analyzed for alkyl phosphates to measure exposure due to organophosphate pesticides. Air samples using Metrical filters will also be taken to measure inhalation exposure of workers. As a means of measuring contamination of the environment in the Sudan, soil, water and plant samples will also be taken.

PUBLICATIONS

NEWSLETTER

INTERNATIONAL CONFERENCE MEETING LIST

PUBLICATIONS

The publications of the Consortium are principally printed materials containing the results or proceedings of short courses in integrated pest management, seminar/workshops in pesticide management and special reports. Except for a small number of priced publications, these materials are distributed free upon request to interested individuals. The Consortium also regularly distributes a periodical newsletter and a list of international conferences related to pest management to persons on the corresponding mailing list.

NEWSLETTER - Since 1975, a periodical newsletter, entitled PEST MANAGEMENT NEWS, has been published by the Pest Management and Related Environmental Protection Project. It is published in both the English and Spanish languages and distributed, at no charge, to more than three thousand individuals in 178 countries. The purpose of the newsletter is to present information on major pest management projects being implemented in less developed countries, to inform readers of printed resources pertaining to crop protection and pesticide management, to announce the presentation of training courses in crop protection related disciplines, and to provide dates and sites of presentation of conferences, meetings, congresses, workshops and symposia that deal with topics in pest management.

A questionnaire on the quality and usefulness of the newsletter was included in the last number of the newsletter issued in 1982 to obtain the views and opinions of the readers of this publication. The readership was polled for their views on the types of information and kinds of

articles that appear in the newsletter and asked to rate the usefulness of four subject areas or features according to five subjective indicators, i.e. whether they agreed, strongly agreed, disagreed, strongly disagreed, or had no opinion. The subject areas surveyed were: (a) CICP activities, (b) reviews of books and commissioned reports, (c) calendar of future events, and (d) reports of conferences, training courses and workshops. Recipients of the newsletter were also asked to express their opinion or preference on the desirability of including new features in the newsletter, e.g. correspondence from the field, articles on controversial topics in pest management, etc., or adding greater emphasis to existing subject areas, such as more book reviews, more calendar of events. Readers were also given the opportunity to express their opinion on the overall usefulness of the newsletter and whether or not the style and format should be changed.

Of the more than 3,000 individuals on the mailing list, 620 persons returned the English questionnaires and 157 returned the Spanish forms, for a response of nearly 25%. The great majority of the respondents (84%-95%) indicated that they found the newsletter of considerable overall usefulness to them. The usefulness of specific features in the newsletter was also attested to favorably by a rate of approval of three-fourths or greater. Despite these favorable results, however, only one-third of the persons returning the survey felt that the newsletter should remain unchanged while another third believed that some alterations should be made; the remaining third either had no opinion or did not answer the question. The response to this reader's survey was very heartening and suggest that there is a need for this kind of publication and that the newsletter has been successful to some extent

in meeting its objectives.

List of International Conferences Related to Pest Management - The Consortium prepares on a quarterly basis, a 20-30 page list of international conferences related to pest management. The list is distributed in January, April, July and October and sent to a selected number of individuals who have expressed an interest in being kept informed of the occurrence of important meetings, workshops, and short courses in this field. The list has proven to be of particular value to scientists in developing countries who wish to participate at these events.

Work in Progress - In 1983, CIGP funded a project to begin development of pictographic materials related to pesticide safety. These audiovisual materials are to be used in training activities intended to teach pesticide safety and to increase the level of awareness of the need for safety by users of pesticides in developing countries. The materials being developed in this project are graphic symbols for use on pesticide labels, advertising copy, and educational materials. Testing of these original pictographic materials was conducted during the summer of 1983 in Ecuador in a study designed to discover preferences potential users might have for particular symbols and designs. Based upon these results, the set of pictographs were revised and subsequently tested anew in California on immigrant and migrant rural workers. This testing was performed on an interview basis and sought to document the individual's interpretation or meaning given to 70 pictographs in 10 subject areas. Based upon these intensive interviews, further revision of these materials will be made.

APPENDIX
SUMMARY OF OVERSEAS
ACTIVITIES OF CONSULTANTS
AND PROJECT PERSONNEL
OCTOBER 1, 1982 - SEPTEMBER 30, 1983

- October 4-20, 1982 Dale Bottrell, Ivor Firman, James Litsinger, Wallace Mitchell, and Roy Nishimoto - Acted as instructors in the Short Course in Methods of Controlling Diseases, Insects and Other Pests of Plants in the South Pacific, which was presented in Tonga.
- November 28 -
December 4, 1982 Donald Calvert and Ray Smith - Attended combined annual ESA, ESC, and ESO meetings held in Toronto.
- November 1 -
December 21, 1982 Patricia Matteson - Participated as crop protection specialist and environmental consultant on the redesign team for the CILSS Sahel IPM Project.
- December 5-11, 1982 Carl Barfield - Worked with Angel Chiri, RPMS, and cooperators from AGMIP, to discuss IPM procedures and experimental design, and future possibilities for the use of IPM in the AGMIP/INCAP project in Guatemala.
- January 6-17, 1983 George Schaefers - Prepared Environmental Assessment on the use of pesticides in the Casamance Regional Development Project, Senegal.

- January 6 - Austin Haws - Assisted USAID/Bolivia Mission
February 5, 1983 in making environmental determinations on the use of pesticides in the Chapare Integrated Rural Development Project.
- February 6 - Dale Bottrell - Consulted with USAID Missions in
March 7, 1983 St. Lucia, Dominica and Barbados, and officials on AID development project and related matters.
- February 21-25, 1983 Michael Irwin and Luis Zavaleta - Keynote speakers at the First IPC Congress of Guatemala, sponsored by AGMIP and the Ministry of Agriculture.
- February 21-25, 1983 Perry Adkisson, Donald Calvert, George Georghiou, Robert Levine, Bruce Mann, Catherine McInerney, and Wesley Yates - Participated as instructors in Bolivia Pesticide Management Seminar/Workshop held in Cochabamba. Calvert also consulted with officials in Lima, Peru, and Quito, Ecuador, regarding possible future IPM courses and workshops.
- March 10-31, 1983 George Schaefer - Prepared an Initial Environmental Examination on the use of pesticides in the Djibouti/AID Food and Nutrition OPG Project.
- March 11-30, 1983 Dale Bottrell - Participated in Disasters and Development Conference in Mombasa, Kenya, visited with REDSO/ESA and ICIPE officials. In Liberia, met with WARDA personnel to discuss future collaborative research and training activities.

- March 25 - Fowden Maxwell - Participated in a team review of
April 17, 1983 ICIPE in Kenya.
- March 28 - Joseph Danauskas - Administered cholinesterase analy-
April 2, 1983 sis training in Dominica.
- March 28 - Leopoldo Caltagirone - Served as technical advisor
April 14, 1983 on biological control of vegetable pests to the
USAID Mission in Sri Lanka.
- March 29 - Jack Drea, Grace Goodell, Christine Hollis, Thomas
June 6, 1983 Irvin, Allen Steinhauer, Janice Tuthill, and Ed Weiler
Performed project redesign for RFCP Project in
West Africa.
- April 3-17, 1983 Keizi Kiritani, Marcos Kogan, Ricardo Lantican, James
Litsinger, Patricia Matteson, S.V.R. Shetty - Par-
ticipated in the International Workshop in IPC for
Grain Legumes held in Goiania, Brazil.
- April 4-16, 1983 Merle Shepard and Angel Chiri - Advised Panamanian
Government and Project officers on the development
of vegetable IPM.
- April 24-30, 1983 Ray Krueger - Discussed pesticide disposal proce-
dures with personnel in Senegal.
- May 1-8, 1983 Jack Beardsley and Ken Hagen - Conducted critical
analysis of IITA proposal for biological control of
cassava pests. Involved travel to Nigeria, Sene-
gal, and the Central African Republic.
- May 8-14, 1983 Virgil Freed and Ray Krueger - In Western Samoa,
discussed pesticide disposal procedures.

May 8-24, 1983

Edward Glass and James Goodwin - Participated on redesign team for AID-financed RFCP Project in Cameroon.

May 22-28, 1983

Angel Chiri, Lou Falcon, Mike Irwin, Katherine Reichelderfer - In Turrialba, Costa Rica, participated on design team organized by ROCAP to assist in developing a PID for a regional IPM Project for Central America.

June 5 -

July 9, 1983

Ray Beal - Consulted with officials in Africa regarding possible substitutes for chlorinated pesticides for control of subterranean termites.

June 13-17, 1983

Ray Smith - Attended International Meeting in Costa Rica on Strengthening of Regional Plant Protection Organizations with Special Emphasis on Latin America and the Caribbean.

June 26 -

July 14, 1983

Dale Bottrell - Assisted USAID on several matters pertaining to use of pesticides in AID-financed projects in Caribbean, travelling to St. Vincent and Barbados.

July 11-16, 1983

Robert Frans and Mike Irwin - In Tegucigalpa, Honduras, participated on a team reviewing IPM training program at the Pan American School.

July 17 -

August 11, 1983

Hal Reynolds, Gerald Carlson, Joseph Danauskas, and Donald Grimes - Team advised the government of Sudan's Gezira Board on pest control of cotton, and prepared a plan of action for monitoring proposed applications of Temik.

July 25 -

August 13, 1983

Patricia Matteson - In Kenya and Zimbabwe, began arranging pest and pesticide management workshop for East and South Africa with REDSO/ESA. Then in Niger worked with the Niamey Department Development Project on design of better crop protection extension program.

September 8, -

November 21, 1983

Hodge Black, Joseph Danauskas, Donald Morgan, and Geoffrey Zehnder - Carried out biological and health monitoring of effects of applications of Temik on cotton in the Sudan.