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Pest Management
and
Related Environmental Protection Project

Final Report
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UNIVERSITY OF CALIFORNIA/AGENCY FOR INTERNATIONAL DEVELOPMENT

PEST MANAGEMENT & RELATED ENVIRONMENTAL PROTECTION PROJECT*

FINAL REPORT

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Cornell University
North Carolina State University
Oregon State University
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University of Florida
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University of Miami
University of Minnesota
Texas A&M University
U. S. Department of Agriculture
Agency for International Development

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ORIGIN AND OBJECTIVES

In 1970 a special committee of the National Academy of Sciences conducted a review of the pesticide procurement and pest management activities of the U. S. Agency for International Development in order to assess the effect of these activities on the environmental quality of developing countries. On the basis of this review, the committee formulated several broad recommendations to improve the AID-supported agriculture and public health programs in these countries. One recommendation strongly urged the formation of a permanent pesticide advisory committee composed of specialists from federal and state agencies, universities, industry and other institutions to advise AID on problems associated with pesticide formulation, packaging, shipment, handling, and on the hazards of pesticides to human health and the environment. Other recommendations urged greater involvement of the agency in efforts to promote the safe and effective use of pesticides, the development and promotion of programs of integrated pest control, increased AID support of research, education and training on all methods of pest control, and the development of a long-term pest management strategy for continued AID assistance to developing countries.

The NAS recommednations led to the formation and establishment of the UC/AID Pest Management Project. On June 30, 1971, The Regents of the University of California signed a contract (csd-3296) with AID in which the University agreed to provide technical assistance in the field of pesticides and pest management to developing countries while maintaining environmental quality.

Although the prcgram thus initiated was known as the University of California/Agency for International Development Project in Pest Management

and Related Environmental Protection (the UC/AID/PM Project), it was a joint cooperative program between AID and several U. S. universities, with the participation of the U. S. Department of Agriculture in an advisory capacity. The universities were the University of California, University of Florida, Cornell University, North Carolina State University, Oregon State University and the University of Miami (Florida), with the first-named institution responsible for coordination and management of the project.

The original contract expired on February 28, 1975, and a second contract (ta-C-1195) remained in force until the termination of the project on August 31, 1980.

Member institutions were mandated to develop their scientific and institutional capacity to train and retrain crop protection personnel from developing countries and to give technical assistance facilitiating the improvement of local research, training and extension programs related to crop protection and pesticide management.

The primary long-term objectives, as specified when the project was created, were to:

- develop on a permanent basis a procedure for backstopping and providing research and technical assistance to USAID missions in pest management and in the evaluation, procurement, and use of pesticides.
- assist less-developed countries in designing safeguards and regulatory procedures for the importation, manufacture, formulation, distribution and use of pesticides, and a pesticide use monitoring system.
- aid countries in developing research and training procedures for the development of scientific and technical skills.

• relate the resulting work to the international cooperative research and technical assistance network.

• assist with the development of country and regional integrated pest management and environmental protection systems.

This project complemented cereal grains improvement projects financed by AID, the international agricultural research network, and the food crop improvement projects financed by other donors with the aim of increasing the food supply in developing countries.

GENERAL PROJECT ACTIVITIES

Provision of technical assistance to AID in crop protection and pesticide management began immediately. Two other endeavors were undertaken at the beginning of the project as a basis for future activities: a review of AID's role in procurement and use of pesticides in the foreign assistance program, with recommendations for the agency's performance in that role, and identification of major pest problems and current pest control and pesticide handling practices in developing countries.

PANEL ON PESTICIDES

As recommended by the NAS, the UC/AID/PM Project established a Panel on Pesticides, composed of five specialists in the fields of entomology, plant pathology, medical toxicology and pesticide chemistry. Members are listed in Appendix IV. The Panel undertook a review of AID activities relating to pesticide formulation, packaging, shipment and handling and the use of pesticides in countries receiving assistance.

It was apparent that an AID pesticide manual was needed for use in planning and executing well-designed pesticide programs in developing coun-

tries. Preparation of the manual was contracted to a consulting firm, who provided the outline, supervised its preparation, reviewed the draft, and furnished important data and references. The Pesticide Manual (Project Publication 42) consists of three parts: 1) Safe Handling and Use of Pesticides; 2) Basic Information on Thirty-five Pesticide Chemicals; and 3) Specifications. It was published in 1972 in two volumes totaling 609 pages. One chapter in Part I on handling, transportation, and storage of pesticides was revised and re-published in 1976.

The Panel also undertook to establish criteria for the identification of especially hazardous materials and assisted AID in setting up procedures to provide extra safeguards for highly toxic pesticides. Another activity was an international mail survey on selected pesticide problem areas. A questionnaire consisting of nine general questions was sent to 54 organizations or individuals on a worldwide basis. Good response (40 percent) was received from the request. The results of the survey are presented in Project Publication 28. The Panel was dissolved in 1973, and the members became part of the larger UC/AID/PM ad hoc Advisory Group.

REGIONAL SURVEYS BY INTERDISCIPLINARY STUDY TEAMS

At the beginning of the project, it was apparent that development of a long-term pest management strategy in the developing countries would require proper identification and evaluation of those pest problems seriously affecting food production. The importance of evaluating the current pest control and pesticide handling practices in these countries was also recognized. The UC/AID/PM Project accomplished these tasks through the use of study teams composed of specialists selected from various plant protection disciplines. Members of all the study teams are listed in Appendix II.

Initial regional surveys were made in 1972 by six teams, each consisting of an entomologist, a plant pathologist, a nematologist and a weed scientist from Project participating universities and the USDA. The teams surveyed six regions (Project Publications 26, 27, 30, 31, 33, and 37):

East Asia:

Philippines	Hong Kong
Thailand	Singapore
Malaysia	Japan
Taiwan	

Near East/Asia:

Turkey	Afghanistan
Iran	Pakistan

Near East/Mediterranean:

Jordan	Spain
Lebanon	Portugal
Tunisia	

Africa:

Senegal	Nigeria
Niger	Kenya
Mali	Tanzania
Ghana	Ethiopia

Central America:

Guatemala	Costa Rica
Honduras	Panama
Nicaragua	Guyana

South America:

Brazil	Bolivia
Uruguay	Ecuador
Dominican Republic	

The Central and South American teams were preceded by a two-person pilot study team which made a preliminary study of conditions in Latin America (Project Publication 23), and the South American team included

a pesticide specialist as the fifth member. A one-person preliminary study of crop protection problems in Morocco and Tunisia was done in 1972 prior to the activities of the Mediterranean team (see Special Studies), and information on the situation in Tunisia was updated by another interdisciplinary group in February 1980 (Project Publication 38). A country report on Bangladesh was complied by a study team in 1975 (Project Publication 43).

Team members contacted disciplinary counterparts in ministries of agriculture, institutes, universities, and others, to solicit opinions on priority pest problems of major food crops and determine the status, effectiveness, and limitations of existing crop protection programs. Each team provided:

- an analysis of the problems encountered,
- recommendations for problem priorities,
- recommendations for research, training and control programs based on the importance of the problems identified and the probability of successful control,
- evaluation of the technical capacity or potential of local scientists and facilities,
- identification of capable people, where possible, who would fit into project training programs, or as degree students in the University,
- identification of needed "institution building" and scope of the need, analysis of the way and extent that the UC/AID/PM Project could contribute to strengthening local capacity to manage these problems, and

- an evaluation of social and cultural problems that might arise as a result of problem solutions and their effects on local agriculture, marketing, and economics.

Plant protection situations encountered by various teams differed greatly between areas and countries. Some findings, however, were nearly universal. There were many critical resource needs, including trained scientists, research facilities and adequate program support funds. In many situations, professional salaries were so low or working conditions otherwise so unattractive that trained scientists were not retained in public service programs. Internal organizational problems, among ministry, university and/or institute groups, inhibited cooperation and collaboration, with resulting duplication of effort and lack of coordination in planning for appropriate priority problem identification. Within these constraints, research and extension services often neglected food crops in favor of export crops.

On the scientific plane, certain problem areas often cropped up. While the major insect pests and some diseases had been identified in most countries, little work had been accomplished with plant viruses. Nematology and weed science were generally neglected although those sciences were involved in some of the most widespread and serious problems. Crop protection research and practice were found to center on pesticide use, and information was generally inadequate or nonexistent on crop losses, economic thresholds for pests, nonchemical control measures and pest bionomics.

Serious problems with storage, handling, distribution, packaging, formulation and application of pesticides were universal. Pesticide use in the developing countries was expected to rise sharply in the near future,

but extension services were generally inadequate and pesticide salesmen tended to be the persons advising farmers. Regulations governing the importation, registration and use of pesticides were unsatisfactory or absent almost everywhere. There was little genuine concern about environmental damage caused by pesticides, and almost no pesticide residue analysis facilities existed.

Subsequent project activities were based on the broad recommendations of the interdisciplinary study teams. Specific suggestions for enhancing research and training capabilities included priority topics for regional conferences and cooperative research, training courses in pest management, the reorganization of some country efforts, the improvement of libraries and other facilities, the recruitment of scientists in underrepresented fields, and increased involvement of specialists and students from American universities. A regional approach to pest monitoring and management was stressed. Also given high priority was the need to improve pesticide management in the developing countries, including the formulation of appropriate legislation and the provision of pesticide residue analysis facilities with properly-trained staff.

PESTICIDE MANAGEMENT SEMINAR/WORKSHOPS

The multidisciplinary study teams found that the misuse of pesticides was a serious problem in many of the countries visited and often led to the presence of high levels of toxic residues on food crops and to the occurrence of literally hundreds of human poisoning cases annually. They reported that improved procedures for pesticide registration, packaging, sampling for residues, were critically needed and recommended that training courses or seminars be presented to assist these countries in improving their capability

to regulate the use of pesticides.

Acting on this recommendation, the UC/AID/PM Project inaugurated a series of seminar/workshops in December 1973, on the subject of pesticide management. These seminars were organized at the request of high government officials through AID missions. They were designed to acquaint participants with the requisite technology essential for the safe, efficient, and economic handling and use of pesticides. They were also intended to encourage and assist the mobilization of national or regional efforts to develop sound, functional programs in pesticide management.

Presentation of these seminar/workshops was predicated on the assumption that improved pesticide management can best be attained through a coordinated interdisciplinary approach utilizing the combined expertise of the medical and agricultural sciences in dealing with the problems posed by the use of pesticides. The agromedical approach and suggestions on how to accomplish such a program were put together in a manual published in 1976 (Project Publication 7).

Each seminar/workshop was oriented to specific local problems and with local cosponsors and cooperating institutions. One to three preliminary visits were made by project personnel to each host country. These were partly fact-finding visits to review local pest management problems, inspect laboratory and training facilities, meet local agricultural technicians and chemists, and develop recommendations for improvement and/or expansion of facilities and further staff training. With this background, the subject matter, objectives and agenda of the seminar/workshops and the follow-up training courses for pesticide chemists were designed in consultation with cosponsors, appropriate government officials, and local pesticide industry representatives.

The fundamental purpose of the seminar/workshop was to develop with the participants a knowledge and understanding of the interrelationship of health, agriculture and the environment of the economy and welfare of their home country. This goal was accomplished through the presentation of three days of technical talks on such subjects as the chemistry, toxicology, chemodynamics, toxicity and hazards of pesticides, the epidemiology and medical aspects of pesticide poisoning, the development of resistance, integrated pest control methods. These talks were followed by two days of separate meetings by the workshop groups who discussed specific problems and developed plans for implementation of a pestcide management program in their home country.

Ideally, such a program would provide for the development of pesticide management or "agromedical" teams within the country and a central clearinghouse unit that would deal with problems of persistence, pest resistance and human pesticide poisoning. The problem of developing the system and organization for the establishment of these teams, clearing-house activity, monitoring and residue analysis program, was discussed at a plenary session on the final day of each seminar/workshop. Recommendations and resolutions were formulated and presented during this session and then, if ratified, they were forwarded and presented to the ministers of the home country government for their consideration and possible implementation.

The involvement of the UC/AID/PM Project in the development of the pesticide management programs in these countries did not end with the conclusion of the seminar/workshops. Project personnel made follow-up visits for the purpose of providing further technical consultation and assistance in the continued expansion and improvement of these pesticide management

programs. In addition, specialized training in residue analysis or operation and use of instruments was provided for in-country chemists. Furthermore, project personnel provided technical assistance in the development of surveillance and monitoring systems for pesticides and in other ways assisted in implementing the recommendations made during the seminar/workshop. The following countries hosted seminar/workshops from 1973 to 1979:

El Salvador

After the seminar/workshop and during follow-up visits, intensive training sessions were given for in-country chemists and technicians, and specific training was arranged in the U. S. for a medical doctor, chemists, and agricultural technicians from the pesticide team.

Existing instrumentation was reviewed and faulty instruments repaired, with maintenance training for staff. New residue analytical methods on a microscale were introduced, including the Michel method for determining blood cholinesterase level, which is employed in the monitoring of insecticide poisoning cases, and the development of a procedure to analyze beef blood used for cattle feed.

After a review of laboratory performance, recommendations were formulated for the development and equipping of a new laboratory, and for the establishment of a pesticides laboratory quality control system with supervision by the University of Miami. This latter became a major component of the UC/AID/PM Project.

Preliminary fact-finding visits and previous research had identified three serious problems for special consideration and further work: pesticide residues in beef, human pesticide poisonings in cotton fields, and Anopheles mosquito malaria vectors that had become resistant to organophosphorous

insecticides. Project specialists consulted on ways to begin handling the problems. These included better pesticide formulations to reduce residue levels, new spray regulations for cotton that were designed to avoid the contamination of water near cotton fields, methods for developing uncontaminated feed sources for cattle, and the monitoring of beef carcasses that come onto the local market.

A report on the El Salvador seminar/workshop in Project Publication 3.

Indonesia

Following the seminar/workshop sessions, UC/AID/PM Project specialists and staff of the Ministry of Health gave a three-week specialized training course in residue analysis for in-country chemists from the provincial health laboratories, research institutes, and government ministry laboratories. The Project donated and installed a gas chromatograph that was used in the instruction.

In 1979, a Project specialist visited Indonesia for one month to assist Department of Health personnel in setting up an interlaboratory quality control program for pesticide analysis on a national level, and to give a two-week training course to improve capability in pesticide analysis.

The proceedings of the Indonesia seminar/workshop are Project Publication 4.

The Philippines

The seminar/workshop, which was attended by representatives of over 50 agencies involved with the use of pesticides in The Philippines, led directly to the enactment of new pesticide legislation by The Philippines government. Proceedings are documented in Project Publication 6.

Project specialists returned to The Philippines in 1976 as consultants to the WHO Regional Seminar on the Safe Use of Pesticides.

Guatemala

The 1976 pesticide management seminar/workshop terminated suddenly after two days when Guatemala was devastated by a major earthquake. Nevertheless, concern about the safe management of pesticides persisted, and several workshop groups submitted the preliminary conclusions they had formulated before the earthquake struck.

The Project received letters expressing interest in having the workshop rescheduled, and, in response, a second regional seminar/workshop was presented in 1978. The project sponsored representatives of FAO missions in Nicaragua and El Salvador and delegates from the Ministries of Health and Agriculture in each of five Central American countries. The reports of the two seminar/workshops are Project Publications 10 and 18.

Egypt

Plans for the Egypt seminar/workshop developed when a team of Project specialists visited Egypt to review pest control and pesticide management practices for cotton. Some of the recommendations formulated at the workshop were that integrated control systems should be implemented on Egyptian cotton as soon as research demonstrated their feasibility, that improved pesticide safety practices for workers be instituted, and that a comprehensive agromedical program for pesticide management should be developed. The report is Project Publication 9.

Later in the year, five Egyptian chemists representing Ain Shams University, the University of Alexandria, the Central Agricultural Pesticide Laboratory, the Regional Radioisotope Center and the Ministry of Health attended three training sessions in pesticide analysis held at the University of Miami under the direction of a Project specialist. More representatives

from Egypt were trained in Miami in 1979.

Colombia

The UC/AID/PM Project sponsored attendance at this seminar/workshop by delegates from the Ministries of Health and Agriculture in five South American countries, as well as Israeli entomologists from the Israel Institute for Biological Research and Kimron Veterinary Institute. A chemical company sent a University of California Public Health Master's degree recipient on a tour of pesticide laboratories in Oregon and Florida, and then to the workshop en route to her home in Costa Rica.

Before the seminar/workshop, Project representatives visited hospitals and agricultural experiment stations in the Tolima Valley to discuss with Colombian officials problems of human pesticide poisonings, disposal of pesticide containers and environmental contamination, and held discussions concerning aerial and ground application of pesticides. At the request of the Colombian government, the Project later sent a specialist to assist in upgrading technical capability in airplane application of pesticides and to participate in a series of seminars and workshops for government technicians in various parts of the country.

Post seminar/workshop activities included a ten-day training session in pesticide residue analysis, a visit by Israeli specialists to CIAT and the coastal livestock rearing region of Colombia to discuss acaricidal resistance in ticks, and a visit by integrated pest management specialists to the Cauca and Tolima Valleys to hold discussions with local growers and government personnel concerning insect pest management for field crops.

Senegal

There is high potential for a marked increase in pesticide usage in

The Sahel due to the recent initiation of several long-term plant protection programs intended to greatly increase food production in the region. Agriculture and public health scientists and technicians from ten West African nations and eight international agricultural aid and crop protection organizations were provided early guidance in proper pesticide use and regulation in an effort to avoid unnecessary adverse environmental impacts. The Proceedings are Project Publication 16.

QUALITY CONTROL PROGRAM FOR PESTICIDE ANALYTICAL LABORATORIES

A number of observations or comments made by the multidisciplinary study teams that visited 32 countries in 1972 indicated there was no capability to conduct pesticide residue analysis in many of these countries. Recommendations were made to provide assistance to these countries to create this capability and also to develop a coordinated program that would assist in the development and maintenance of uniform standards of operation among pesticide residue laboratories of participating countries. Early in 1974, a subcontract was negotiated between the University of California and the University of Miami, Florida, for the purpose of providing the services of a qualified specialist in analytical pesticide chemistry who would develop and direct this program and who would also conduct follow-up training to the UC/AID Project's Seminar/Workshop in Pesticide Management.

The quality assurance program was initiated by sending a questionnaire to selected laboratories to determine their interest in participation. They were advised that the purpose of the program was to measure the overall performance of each participating laboratory, to evaluate the methodology used in residue analysis, and to determine any specific training needs that would be required to upgrade and standardize their performance. USAID Missions

were also notified of the program and were kept informed of its progress.

Fifteen laboratories in nine countries expressed interest in participating in the program and, in late 1975, the first quality control sample was sent to them. This sample consisted of a hexane solution containing several known pesticides; subsequent samples consisted of agricultural products (solutions of pesticides added to vegetables, fruits and beef fat) and environmental substrates (solutions of pesticides added to water). Methodology for performing the analysis was included with the samples, but the laboratories could use other methods as long as they specified the method used. The laboratories were asked not only to identify what pesticides were in the sample, but also to determine the concentration of each pesticide present.

After the data on a particular sample were received, the results obtained by the laboratories performing the analysis were summarized by the University of Miami, and a constructive critique was prepared and sent to each participating laboratory in order to help it improve its performance. This report presented the data in coded form so that the individual laboratories were not identifiable to each other, yet each could still compare its performance with the others. The progress of each sample was monitored through use of a flow chart and, if after a certain lapse of time a response was not received, the laboratory was sent a follow-up letter.

The critiques sent to the laboratories included a statistical evaluation of the results and an analytical performance rating which compared the performance of all the laboratories. Strict confidentiality of the results was maintained by use of the coding system mentioned above. The most frequent errors encountered in the analyses of these samples were (in decreasing order of occurrence): (1) incorrect standard concentrations,

(2) improper use of gas chromatography, e.g., wrong column, (3) poor recoveries through improper use of methodology, and (4) mathematical errors. Evaluation of the results submitted by participating laboratories enabled program staff to determine the type of training necessary to improve their performance and to identify laboratories in need of training.

A ceiling of 45 laboratories was eventually established to permit the most effective management of the quality control program. Samples were sent to these laboratories every three months. If a laboratory did not return the sample receipt form or did not answer the follow-up letter, a questionnaire was mailed to find out why it had not continued participation in the program. Among the reasons cited by laboratories in explanation of their irregular participation were a lack of solvents or other supplies and a change of personnel. Those that did not respond to any correspondence were replaced by other interested laboratories.

In June 1977, short training programs were initiated at the University of Miami for particular individuals as a complement to the quality control program. This specialized training gradually evolved into formal six-week courses that were presented at the rate of two a year. These courses provided practical knowledge in sample extraction and cleanup, use of analytical equipment and identification/quantitation, in addition to the presentation of basic information on the chemistry and fate of pesticides in the environment. Five courses were given during the contract period training 13 representatives from eight countries. The majority of the trainees were chemists assigned to analytical laboratories, but with little or no previous training in pesticide residue analysis. Each course was adapted as much as possible, within the established schedule, to meet the needs of the students. An evaluation

test was given at the beginning and end of the course to determine if the training accomplished the desired objectives.

In addition to these six-week course, seventeen short training sessions of two weeks or less, specifically tailored to individual needs, were held in Miami. Twenty-three representatives from nine countries attended these sessions.

Another aspect of the training program was the presentation of short training courses of two to three weeks duration in conjunction with Seminar/ Workshops in Pesticide Management or at other times upon request of the AID Missions. Apart from these short courses, the director of the program made several site visits to different countries to evaluate laboratories and equipment, determine training needs and/or select a suitable training location.

Most of the laboratories participating in the quality control program were operating under less than ideal conditions, and it is noteworthy that their performance in this program, in many cases, improved considerably after training was received in Miami or in their own country. Two laboratories improved their performance by following suggestions made in the critique of their analysis of particular samples. It should be noted that samples were deliberately made increasingly more difficult, so that even if a laboratory's performance rating remained the same, its actual performance was showing improvement.

Another important component for assuring the reliability of data issuing from a pesticide analytical laboratory is the development of an manual that provides standardized procedures and methodology for analyzing samples. The University of Miami developed such a manual (entitled "Manual

for Training in Pesticide Analysis") for use by the laboratories participating in the quality control program and others requesting it and for use in training courses. The methods described in the manual were chosen for their simplicity of use and effective coverage of the methodology. The manual was prepared in a looseleaf notebook to permit the easy inclusion of corrections and additions.

The analytical methods contained in the manual consist of those used or required to insure compliance with regulatory actions in the United States. The methods have either been collaboratively tested among a series of laboratories with appropriate statistical confirmation of results, or have been subjected to recovery studies with the recoveries stated, and are recognized by law as the methods of choice. The manual is available in English, Spanish and French, and copies have been provided to 29 developing countries thus far. The training manual is supplemented by an active file of literature on methods and research progress to enable program staff to respond to requests for methodology on the analysis of specific pesticides.

Apart from the quality assurance program and its training activities, the staff of the analytical laboratory at the University of Miami has utilized their expertise to assist in the analysis of samples during emergencies when asked to do so by AID. For example, the Miami laboratory analyzed 155 samples for the Instituto Centroamericano de Investigación y Tecnología Industrial (ICAITI) after the latter's laboratory was damaged during the 1976 Guatemala earthquake. Also, following a request from USAID, the Miami laboratory developed a sampling plan for monitoring water from Santo Domingo Bay after 200 drums of Azodrin were washed into the bay as a result of a hurricane that struck the Dominican Republic in 1979. This plan was developed

in consultation with a local engineer and samples were analyzed until the drums were located.

SHORT COURSES IN PEST MANAGEMENT

The UC/AID/PM Project interdisciplinary study teams recognized a need to provide training for personnel in developing countries in the principles of integrated pest management. In response to this need, the project held five IPM short courses with the following objectives:

- to provide participants with a working philosophy and concept of pest management,
- to provide information on the latest developments in pest control technologies and an assessment of their potential,
- to provide participants with new ideas and approaches to the pest management problems they face in their home countries,
- to develop a dialogue between the workshop participants and contributing staff for the purpose of seeking solutions to mutual problems, and
- to provide an opportunity for participants to establish contacts and friendship with other entomologists which would likely lead to continuing communication among them to their mutual benefit.

Pre-Congress Workshop in Pest Management, Ithaca, New York

An intensive five-week training workshop in agricultural pest management, organized in 1976 in cooperation with Cornell and North Carolina State Universities, was attended by entomologists from fifteen developing countries in Asia, Africa, and Central and South America. Participants began by

reviewing pest management philosophy, principles, history, new technologies, strategies and observations of ongoing projects in New York State. They went on to hold supplemental discussions and review pest management projects in North Carolina, and travelled through agricultural areas of several other states to observe crop protection problems and visit with research and extension entomologists working toward solutions to these problems. Activities concluded with attendance at the XV International Congress of Entomology in Washington, D. C. The course report is Project Publication 32.

Peru Short Course on General Principles of Integrated Pest Control, Lima

This six-week course in 1978 placed emphasis on pests and diseases of corn and soybeans, and was attended by 70 students, research and extension personnel, and private company employees from Peru, Ecuador and Colombia. The complete set of lecture materials (Project Publication 12) was printed in Spanish and distributed to libraries throughout Peru.

The course consisted of five phases. The first phase covered general principles of integrated pest control and a review of the fundamentals of entomology, plant pathology, weed science and nematology. The second was a short review of the major tactics of integrated pest control. A review of integrated pest control systems for major crops was presented in the third phase while the fourth phase covered the regulatory aspects of pest control, use of pesticides, and protection of the environment. The last phase was an analysis of future prospects and needs for integrated pest control in the several geographic regions of Peru and in the neighboring countries of Ecuador and Coloumbia.

In November 1979, an evaluation of this course was held in Huancayo in conjunction with the XXII Meeting of the Entomological Society of Peru.

This evaluation was intended to review the activities of the participants since the end of the course and learn to what extent they had been able to incorporate or implement the integrated control philosophy in their research, teaching and extension programs. Twenty-eight former students attended the Huancayo meeting and submitted written course evaluations to project representatives. In their written responses, the majority of the participants indicated they had benefitted from taking the course and were making efforts to use the information they had obtained in their own work. There was a significant effort made by the students to transfer and use the information they acquired during the course to growers, heads of cooperatives, policymakers and administrators, and although this effort was often vigorously pursued, it suffered to a great extent by a lack of administrative and financial support.

FAO/USAID Short Course on Integrated Pest Control, Maligaya and Los Baños, Philippines

The thirty-three trainees included extension, research and teaching personnel from nations participating in the FAO Inter-Country Programme for Integrated Pest Control in Rice in South and South East Asia.

Topics included pest population dynamics, methods of sampling and analysis of data, determination of levels of pesticide resistance, evaluation of parasite and predator effectiveness, selective use of pesticides, monitoring and forecasting methodology, ecosystem analysis and modeling, crop loss assessment and economic injury levels. In addition, the students participated in an in-depth analysis of specific rice pest problems of the region and reviewed the objectives of the FAO Inter-Country Programme. The compilation of lectures and country reports from this 1978 course is

Project Publication 17.

International Short Course on Plant Resistance Breeding, College Station, Texas

The UC/AID/PM Project and Texas A&M University jointly sponsored this two-week course in 1979 for plant protection specialists and plant breeders from developing countries. The first part of the course was presented on the Texas A&M University campus at College Station and consisted of lectures, laboratory exercises, and field demonstrations concerning principles and techniques for breeding insect- and disease-resistant varieties of cotton, sorghum, rice, corn, peanuts, forage grasses and some grain legumes. The second part provided for participation by the trainees in the IX International Congress of Plant Protection, Washington, D. C., August 5-12. The combination of those two parts provided the participants with exposure to the modern interdisciplinary approach to plant protection. The compilation of lectures from this course in Project Publication 19.

UC/AID - CATIE Short Course on Integrated Pest Control for Small Farmer Cropping Systems, Turrialba, Costa Rica

This four-week course was sponsored by the UC/AID/PM Project in cooperation with the Centro Agronómico Tropical de Investigación y Enseñanza and the Organismo Internacional Regional de Sanidad Agropecuaria (El Salvador), and held at CATIE's headquarters in Turrialba in 1979. Crop protection workers from eight Central American countries heard lectures and participated in laboratory exercises and field demonstrations covering a wide range of topics. These included the principles, tactics and economics of integrated pest control, information sources and retrieval, agroecosystem concepts and pest management, management analyses of major pests in small farmer cropping systems, information transfer to farmers, and country-by-country analysis of pest management problems and planning. Lectures and

country reports presented during the course are compiled in Project Publication 15.

PLANNING AND SUPPORT FOR INTERNATIONAL RESEARCH PROJECTS AND CONFERENCES

The interdisciplinary study teams that visited developing countries identified a number of pest problems that they considered could be profitably addressed by means of adaptive research projects. The UC/AID/PM Project subsequently organized and supported research activity and conferences designed to mobilize international expertise.

Strengthening Crop Protection in Asia

This program was developed by the UC/AID/PM Project ad hoc Advisory Group, to be executed in coordination and cooperation with Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT). Two Project specialists visited CIMMYT headquarters in Mexico in August 1974, to review the proposed scheme. They found that the magnitude and diversity of crop protection problems throughout the maize-growing regions of the developing countries was too great to be handled by a few scientists working from a single institute. Moreover, most essential crop protection research must be conducted locally and can best be accomplished by resident scientists. Although the Project team concluded that the proposed UC/AID/PM project for strengthening crop protection in Asia could not be readily done by CIMMYT even with additional funding, they observed that such a project would complement and strengthen CIMMYT's program and be of direct assistance in terms of evaluating their maize populations in Asia and adapting them to local pest complexes.

International Meloidogyne Project

The UC/AID/PM interdisciplinary team reports led directly to the creation of a project entitled "Research on Integrated Crop Protection Systems

with Emphasis on the Root-Knot Nematodes (Meloidogyne spp.) Affecting Economic Food Crops in Developing Nations," funded by AID under Contract no. ta-c-1234 with North Carolina State University.

The root-knot nematodes were selected because of their overall importance throughout the world as limiting factors in food production. Their worldwide distribution, extensive host ranges and involvement with fungi, bacteria and viruses in disease complexes, rank them high on the list of disease agents affecting the world's food supply.

Objectives of the project were to determine the species and biotypes of the root-knot nematodes present within each geographic region, determine the susceptibility and/or resistance to nematode attack of the currently grown basic food crops in each region, and establish a bank of information on cultivars which display resistance to any or all of the species of root-knot nematodes identified in the proposed study regions. The international effort involves a research center at North Carolina State University and cooperative research with scientists from 50 foreign countries working through six overseas regional laboratories.

Sahel Crop Pest Management

With the resumption of more normal rainfall patterns in 1974 in The Sahel region of Africa following several years of severe drought, a return to the average yields characteristic of food crop production in the area had been expected. However, due to the occurrence of severe attacks on these crops by insect pests (primarily several species of grasshoppers) beginning in April and continuing through the end of the harvest period in November, this return to normalcy did not occur.

After a field inspection of the affected area in October of 1974,

the U. S. decided to organize an informal international meeting of donor nations and multilateral donor organizations in order to determine a course of action for the development of a long-term pest control capability on food crops for the region. The meeting was held in Washington, D. C., on December 11-12, 1974. UC/AID/PM Project specialists were the rapporteurs, and the Project prepared and published the conference report (Project Publication 41).

The primary objectives were to establish a technical understanding of the problem and to develop a consensus from the standpoint of professional pest control management on the most appropriate approaches for the improvement of plant protection programs in The Sahel area. The conference considered both short- and long-term approaches to the pest problems of the region and agreed that urgent attention should be given to the establishment of a pest surveillance and information network for The Sahel region. The conference also recognized the need for the development of sound infrastructures in national plant protection programs which would require varying support in relation to the needs of particular countries. The long-term requirements of the region with regard to institutional capabilities, coordinating mechanisms, resource support for research and training needs, was also reviewed.

Conference activities and conclusions resulted in the creation of Sahel regional IPM projects by both AID and FAO. UC/AID/PM Project specialists contributed substantially to the design and implementation of both.

Pest Management Systems for the Control of Cotton Pests

The UC/AID/PM Project influenced the development of a program to

implement multinational programs of ecologically-oriented pest management systems in cotton and the coordination that would be required among the global, regional, and national programs. This was the subject of a FAO/UNEP Meeting on Pest Management Systems for the Control of Pests of Cotton, held in Karachi, Pakistan, October 1975. UC/AID/PM Project specialists attended as the U. S. delegation.

The environmental consequences of cotton pest control practices and the present and future role of conventional pesticides in cotton were discussed. The status and potential of control methods other than pesticides in pest management systems for cotton were given special emphasis, with separate discussions on host plant resistance, parasites and predators, entomopathogens, habitat manipulation, and the use of behavior modifying chemicals. On the final day of the meeting, there was a review of proposed subregional programs, and draft project proposals were formulated.

International Workshop on Ecology and Control of Bacterial Wilt Diseases

An international planning conference and workshop on the ecology and control of Pseudomonas solanacearum, was presented in 1976 by the Department of Plant Pathology, North Carolina State University, with financial assistance from AID and the UC/AID/PM Project, for the purpose of coordinating worldwide efforts to obtain effective control of this very important pathogen. The conference was attended by over 50 scientists from 23 countries.

At the beginning of the conference/workshop, the participants were organized into three task force committees and asked to consider the current status and need for research in strain identification and variability of

of the organism, soil ecology, genetics of disease resistance in various hosts, and improved methods for development of resistant varieties. The committees assessed the current resources, personnel and facilities available in the world to work on these problems, and also evaluated specific needs for funding ongoing research programs and new projects. Based on this assessment and evaluation, the committees developed specific research proposals for programs that would be needed to facilitate the development of more effective control measures for this disease. Three subcommittees were appointed at the end of the conference to solicit the support of international agencies and local governments for implementation of the recommendations of the task forces.

Project Publication 39 includes the text of invitational papers, the research proposals developed by the conference, and numerous country reports describing the current status of bacterial wilt research in the participants' countries of origin.

The Philippine/AID Pest Control Project

At the request of AID's Technical Assistance Bureau, Washington, D. C., UC/AID/PM Project specialists travelled to The Philippines in 1976 to assist in the preparation of a Project Review Paper for that country's proposed pest control project. It was being initiated for the purpose of developing a National Crop Protection Center (NCPC) and seven Regional Crop Protection Centers which would conduct research and training in crop protection and pesticide management and provide scientific advice to The Philippines government for formulation of policies and regulatory programs.

The Project specialists formulated administrative mechanisms to allow cooperation and interaction among existing crop protection agencies

and the new centers, and helped establish the respective roles of the national and regional centers. During the review process, they investigated the liaison between the College of Agriculture and NCPC, talked with officials of the Bureau of Plant Industry concerning Philippine extension, applied research, and training, and toured several research facilities that had been suggested as sites for the project. In conclusion, they expressed approval of the overall concept while pointing out some real or potential problems that must be resolved, and felt that the Philippine crop protection centers should serve as a nucleus for the development of an intercountry crop protection research and training network for the Southeast Asian region.

Crop Protection in Southeast Asia

The Southeast Asian regional network for crop protection research and training that was suggested by UC/AID/PM Project consultants to The Philippines in 1976 was initiated in 1978 with Australia as the major supporter. Project specialists, other overseas experts, and senior technical officers responsible for pest control, research and extension, policies and administration in seven Southeast Asian nations attended an FAO Technical Consultation on an Intercountry Programme for Integrated Pest Control in Rice in South and Southeast Asia in Bangkok in 1978. The conference was devoted to the development of a detailed draft project with the objective of promoting and accelerating the development and application of IPC in the rice-cropping system together with associated crops in each of the participating countries, as part of an intercountry cooperative program.

The UC/AID/PM Project cosponsored a short course on rice IPC in The Philippines in 1978 as part of the training component of the project.

Coffee Rust Workshop

The Latin America - U. S. Cooperative Coffee Rust Workshop in 1977 supported in part by the UC/AID/PM Project, was held during the XVII Annual Caribbean Division meeting of the American Phytopathological Society in Miami, Florida. Representatives from producer countries, the coffee industry, the USDA and the Project were in attendance, including several researchers from countries which grow coffee but who do not usually participate in APS Caribbean Division meetings.

Participants presented summations of innovations in applied and basic research on coffee leaf rust in their countries and discussed U. S. Cooperative Programs and use regulations for pesticides in coffee culture. The workshop ended with a visit to the USDA Subtropical Horticulture Research Unit, where the world coffee germ plasm collection is cultivated.

Pest Management for Food Crops in Indonesia

In 1979, at the request of USAID/Jakarta and the Government of Indonesia, a team of three UC/AID/PM Project specialists travelled to Indonesia to discuss possible activities of the Project in the broad area of plant protection and environmental protection. Their activities included planning for a future pest management short course, a pesticide management seminar/workshop, and a research/demonstration project on biological control of the brown planthopper. The team also prepared a major revision of the Project Identification Document for a new country project on Pest Managment/Food Crops.

SPECIAL STUDIES IN PEST MANAGEMENT

Pest Problems and Crop Protection Activities in Morocco and Tunisia

A UC/AID/PM Project plant pathologist travelled to Morocco and Tunisia in 1972 to survey pest problems and crop protection activities, with emphasis on cereal crops. Local institutions of higher learning and agricultural research and extension facilities were surveyed, as well as contact persons for future activities. Included in the study were major crops, pest and disease problems, crop losses, control measures employed, pesticide regulations and handling, quarantine procedures, residue monitoring activities, and infrastructure necessary for implementing pest management activities. Regional work on pest management programs for cereals was recommended, as well as increased training of local research, education, agribusiness and extension personnel.

Early in 1974, USAID/Tunisia requested assistance in determining whether Bayoud, a very serious Fusarium wilt disease, was present in date palm plantings. A collecting tour of oases revealed no evidence of Bayoud, but it was urgent that the region be able to detect and eradicate future introductions. A list of recommendations was developed for an emergency detection plan and for disease resistance breeding and screening.

Other date palm disease, pest, and nutrition problems were observed but seemed of less immediate importance. One item of particular interest was the serious problem of Fusarium root rot of wheat in 1974 and the lesser importance of Septoria leaf spot which was identified earlier as a serious pathogen.

Analysis of Pesticide Handling and Use in South Vietnam

A UC/AID/PM Project specialist travelled to Vietnam in 1974 to

investigate problems relating to pest management policies and procedures, with particular attention to the safe and efficient employment of pesticides in plant protection. The investigation included field observations in two major agricultural areas and contact with personnel in public and private agencies. The report, Project Publication 29, cited the great need for improved and enlightened pest management in South Vietnam, especially a better information and educational base and a stronger technological and managerial basis for pest management in both the private and governmental sectors. Fourteen recommendations for achieving these goals were formulated and evaluated in terms of upgrading personnel, improvement in materials and methods, acquisition of information, occupational and public health, environmental protection, regulatory activities and improved communcation.

Insect Problems on Forages on North Andros Island, Bahamas

Two visits were made to North Andros Island in 1974 to appraise insect pest problems of annual and perennial forages. Observations included an appraisal of natural enemy activity, evaluation of agronomic practices and botanical plantings as influencing insect pest abundance, and a listing of potential insect pest species.

Insecticide applications had been ineffective in controlling observed pests, and recommendations were drafted for instituting an integrated pest management program for forage crops. This approach maximized dependence on advantageous weather conditions, natural enemies and "non-preferred" grass and grain species.

It was felt that an entomologist experienced in insect pest management should be assigned to the project with cooperation from local agronomists. Continued pest monitoring and thorough investigations of the natural enemies

of pest species and their parasitism and predation rates, the possible importation of biological control organisms, and pest problems in relation to time of planting and grass species established were suggested in order to develop tools for nonchemical pest management. Greater liaison with the Bahamian Ministry of Agriculture was urged to enhance data collection and the application of project expertise to future pest problems.

Pest Management Research in Pakistan

Also in 1974, the Project provided the services of an entomologist to act as advisor to a USDA/ARS team reviewing a newly-funded project in Pakistan on pest management research on rice, maize, sugar cane and cotton, to be administered by the Agricultural Research Council of the Government of Pakistan.

Preliminary visits to various research and other institutions in Pakistan were considered necessary in order to achieve a grasp of research facilities and capabilities prior to the preparation of a plan of work. In this regard, the 1972 UC/AID/PM multidisciplinary study team report, "Plant Protection in Turkey, Iran, Afghanistan, and Pakistan," was considered a valuable background document.

A comprehensive report on the results of their trip indicated that the success of the project would depend heavily on whether a competent U. S. plant protection advisor could be headquartered in Pakistan to work closely with the project coordinators, particularly during the initial two years of the project, and that USAID would be one of the more likely agencies to provide such an advisor, perhaps by means of the Agricultural Research Development Loan recently awarded Pakistan.

Rice: Field Losses to Insects, Diseases, Weeds, and Other Pests

A special report on crop losses to rice pests was compiled in 1975 for the UC/AID/PM Project by three specialists who presented some representative loss data from some of the more important rice-growing regions and for some of the more significant pests in the field in order to call attention to the extent to which pests affect rice yields in developing countries, and thereby, to the great need of these countries for effective crop protection schemes.

Losses to insects, diseases, nematodes, weeds, rodents, snails, crabs and birds are all discussed, and there are sections on an overview of losses and plant protection and high-yielding varieties. The report consists of selected examples and is not a review of all relevant literature; a list of references is included at the end. For the most part, examples considered are from literature published since 1966, although those papers occasionally treat losses which occurred earlier. The language of the report is technically accurate but can be readily followed by the non-scientist.

Pest Management and Pesticide Management in the Arab Republic of Egypt

A six-member U. S. delegation, consisting of the UC/AID/PM Project Director and five Project consultants, met with Egyptian scientists and administrators in 1975 for a week-long series of talks on the current cotton pest and pesticide management situation in the Arab Republic of Egypt. An analysis of the status of several important cotton pests was made, with recommendations for research and control.

It was found that since reasonable economic thresholds for the pests of cotton in Egypt did not exist, excessive pesticide usage had occurred,

resulting in increasing effects on the total arthropod fauna of Egyptian cotton fields and the rise to pest status of additional insect species, such as the cotton bollworm, whiteflies, jassids and stink bugs. A refinement was recommended in the insecticidal control practices directed against the two key pests -- the Egyptian cotton leafworm and the pink bollworm -- through the use of reduced dosages, selective insecticides, and proper timing. The team emphasized the need for intensive research to redefine the economic injury levels of these two key pest species.

The U. S. delegation also suggested that consolidation of the pesticidal screening effort into a smaller, but more tightly organized and administered effort would free the time of a great many other scientists who then could place more emphasis on studies of economic thresholds, biological control, population dynamics, environmental manipulation and host plant resistance. The findings and recommendations of this U. S. team of entomologists were compiled into a report entitled, "Pest Management and Pesticide Management in the Arab Republic of Egypt" (Project Publication 1).

Again in 1980, the UC/AID/PM Project sponsored a specialist to review plant protection activities in Egypt and identify problems. Recommendations included:

1) Adopt greater flexibility in choice of compounds and application schedules needed for the most effective pest control.

2) By utilizing economic threshold information for cotton pests in Egypt the practice of spraying on the basis of need could be reinstated.

3) The extension service should be reorganized and expanded.

4) A comprehensive study was needed to unify research efforts and coordinate responsibilities between staff of the Ministry of Agriculture and the universities.

5) Incentives to cotton growers should be enhanced to prevent the diversion of inputs to other, more lucrative crops. Farmer expenses should be lowered by eliminating unnecessary insecticide applications.

6) The law guaranteeing college graduates employment within the public sector should be reappraised and restructured.

7) High labor costs could be ameliorated by applying the above recommendations, thus increasing production and disposable income of farmers.

Further recommendations were made in connection with the probable future increase in herbicide use, safe application of pesticides, reorganization needs in the extension service, and coping with pest problems that may arise from the expansion of soybean acreage.

Potential Pesticide Contamination at a Research Station in Colombia

At the request of USAID/Bogota, a visit was made to Colombia in 1976 to provide advice concerning the possible pesticide contamination of the fish ponds in the INDERENA Aquaculture Research Station near the village of Repelón in the Atlantic Province of Colombia.

The consultant reported that with the development of a new irrigation district in Repelón in 1973 and the subsequent introduction of cotton, tomatoes, bananas and other irrigated crops in the region, there was concern about the compatibility of this agriculture and the research station. This was especially true with reference to the potential likelihood of pesticide contamination of the fish ponds on the Repelón station from aerial spraying

of cotton. The Minister of Agriculture of Colombia appointed a special committee to study the situation and assist in resolving the conflict of interest.

It was concluded that the technological problems of protecting the Repelón station from pesticide contamination did not seem to be difficult; therefore, it was unwise to consider moving or abandoning the Repelón station. Instead, the establishment of a barrier strip of trees and vegetation around the station was recommended as well as the prohibition of spraying the station or barrier, overflights of crop dusting aircraft, and spraying in the area at higher wind speeds. Additional recommendations were for training of station personnel in emergency measures to be taken if the water supply was suspected of being contaminated, and for a public relations campaign in the local community to develop understanding and good-will toward the Repelón station and its purpose.

Information Systems For Alternative Methods of Pest Control

A special report on the problems of access to pest management literature, with special reference to the problems and needs of crop protection specialists in developing countries, was prepared for the UC/AID/PM Project. This report reviewed the problems and progress of information systems as related mainly to nonchemical methods of pest control and discusses the requirements and difficulties confronting pest management specialists throughout the world in retrieving information relevant to their needs.

The goals of this study were to identify the major problems commonly encountered by pest management specialists involved in literature searches, review the application, potential and limitations of major literature

search systems and services by comparing their accuracy of retrieval, geographical application, data bases, and availability, discuss current progress to improve the systems, and develop recommendations relevant to needed changes.

As a method of solving the situation described in the report, the authors recommended the formation of an international information project center for alternative methods of pest control that would consist of a network of participants from both developed and developing countries to assist in searching, collating and disseminating information.

The Mediterranean Fruit Fly in Central America and Panama

At the request of USAID's Regional Office for Central American Programs (ROCAP) and under the sponsorship of the UC/AID/PM Project, an interdisciplinary study team of U. S. plant protection specialists conducted an on-site investigation of the pest status and economic importance of the medfly in the Central America and Panama (CAP) region in 1977. The seven-man team was composed of three entomologists, an agricultural economist, a horticulturist and a quarantine specialist. The scope of this study was to gather and evaluate data on the impact of medfly and other fruit fly species (Anastrepha spp.) on fruit production and the economy of CAP countries so that recommendations could be made to CAP policymakers concerning the appropriate course of action to follow for the control of these pests.

In appraising the medfly's status as a pest of citrus in the CAP countries, the UC/AID team concluded, on the basis of their observations and discussions with knowledgeable people of the region, a review of the literature and an analysis of the reports from other investigative studies,

that the medfly was only a minor pest of a minor crop, causing very limited economic damage. In estimating and assessing damage of the medfly on coffee, its principal host in Central America, the team noted that it was the predominant opinion of the producers and scientific workers that the medfly was not causing any loss in production or quality of coffee.

The team concluded that the low economic losses attributed to medfly and related species did not justify the high cost of an attempted eradication program. In addition, sufficient trained personnel and an adequate data base for planning and developing an eradication program were not available. They therefore recommended the adoption and implementation of an integrated pest management program which would strengthen the present relatively low levels of medfly detection and control efforts and would be a more realistic and logical approach commensurate with the importance of the medfly as a pest in the CAP countries.

Although the team's assessment of the medfly situation should be considered only a prelude to in-depth research on fruit flies and other pests of fruit production, their report did succeed in placing the medfly in a realistic perspective in relation to the various fruit production problems encountered in Central America and Panama.

This report is Project Publication 36.

Investigation of Declining Citrus Production in Peru

In 1977, at the request of USAID/Lima, the UC/AID/PM Project sponsored a plant pathologist to Peru to study citrus plantings, with special emphasis on the role of virus diseases in the significant reductions in fruit yields during the previous six years. With plant pathologists of the Ministerio de Alimentación y Agricultura and fruit specialists at the Estación Experimental

Agraria La Molina CIRA I, observations were made in representative orchards in the central coast from Huaral in the north to Chincha in the south. Lectures and conferences were held with local agricultural scientists on citrus resistance breeding and pathology.

The survey revealed no serious disease problems in citrus orchards. Rather, loss of production was apparently due to improper orchard management. The UC/AID/PM Project specialist recommended that Peruvian citrus research and extension programs be strengthened. Priority projects were identified, and suggestions were made for collaborative links between Peruvian and American institutions for a program of citrus improvement, possibly with USAID support.

Development of Pest Management Strategies in Haiti

In 1978 the USAID Mission in Haiti requested assistance concerning the use of pesticides in a planned agricultural project, and the UC/AID/PM Project sponsored an entomologist to carry out this assignment. Initial investigation of the local pest management situation revealed that most farms were small and multiple-cropped, farmers were illiterate and pesticide technology was unavailable to them, comprehensive current pest information was incomplete or nonexistent, and no extension service existed. After conferring with Mission and University of Haiti personnel, it was agreed that emphasis of the visit should be placed on studying nonchemical control methods and developing a knowledge base for implementing such strategies in the near future.

Objectives, procedures, and a tentative budget were developed for a pest/natural enemy survey for crops and livestock in Haiti. It included pest collection and identification, pest damage assessments, natural enemy

studies and a survey of local cultural practices with relation to pest problems. The results were to form the basis for non-pesticide-oriented IPM programs which would rely heavily on biological and cultural controls and resistance varieties.

Pesticide Usage in Jordan

In early 1980, the UC/AID/PM Project obtained the services of an entomologist to collaborate with USAID/Amman in advising the Government of Jordan on the use of pesticides in integrated pest management. The report reviews present pesticide use patterns and pesticide legislation, and details potential hazards and problems. Four major recommendations were made for improving pesticide and pest management in Jordan: (1) the development of a pesticide-related illness monitoring program, with USAID support and pesticide-management consultation from the UC/AID/PM Project; (2) a review of pesticide registrations and establishment of an applicator training program, perhaps in conjunction with the presentation of a Pesticide Management Seminar/Workshop sponsored by the UC/AID/PM Project; (3) the establishment of a pesticide residue laboratory in Amman, with USAID support and UC/AID/PM Project assistance with training for staff chemists and a quality control program; (4) the support of research on integrated pest management and the strengthening of the information delivery system to farmers and pesticide applicators, with assistance from AID consultants or Title XII grants.

Cardamom Mosaic Virus in Guatemala

In 1980, following a preliminary survey in Guatemala of the virus disease of cardamom, a seminar was presented by a UC/AID/PM Project specialist to representatives of the Cardamom Growers' Association discussing the

potential of enzyme-linked immunosorbent assay (ELISA) to detect infected plants, and demonstrating the technique for this treatment. A helicopter tour arranged by the Ministry of Agriculture and the Growers' Association revealed that the virus was infecting most plantations in the southern region and was spreading by infected propagating material and by aphids. Immediate control measures were recommended in the northern areas, where eradication appeared possible.

The Cardamom Growers' Association agreed to provide the U. S. specialist with a grant for purification of the virus and the production of antisera, and for the adaptation of ELISA for the rapid detection of infected plants.

SUPPORT FOR USAID PESTICIDE POLICIES

In 1976, as a result of a civil suit brought against AID by various environmentally-concerned organizations, two actions were taken which significantly influenced AID policy with respect to the supply and use of pesticides: an amendment to Regulation 16 of the Code of Federal Regulations by the addition of a new part 216 on Environmental Procedures, and the adoption by AID of Interim Regulations on assistance for the procurement and use of pesticides.

The amendment to Regulation 16 was to assist AID in the implementation of the requirements of the National Environmental Policy Act of 1969. These procedures were developed to ensure that environmental factors and values are integrated into the decision-making process and to assign responsibility within the Agency for assessing the environmental effects of its actions. The regulation states that it is within the framework of AID's environmental

policy to ensure that the environmental consequences of proposed AID-financed activities are identified and considered by AID and the host country prior to a final decision to proceed, and that appropriate environmental safeguards are adopted. It is further policy to assist in strengthening the indigenous capabilities of developing countries to identify and evaluate the potential environmental effects of proposed development strategies and projects, and to select, implement and manage effective environmental protection measures. The regulation also states that it is AID policy to identify impacts upon the environment resulting from its actions including those elements of the world biosphere which are the common natural and cultural heritage of mankind.

The AID Interim Regulations on provision of assistance for procurement and use of pesticides superseded sections of Part IIC - Pesticides of the AID Commodity Eligibility Listing. These Interim Regulations stated that AID would not provide assistance for the procurement and use of DDT (except for public health use), aldrin and dieldrin (except for restricted use), 2, 4, 5-T, chlordane, or heptachlor. Further, AID would not provide assistance for the procurement of pesticides which are not registered by the U. S. Environmental Protection Agency (USEPA) for the requested use or which are under any other restrictive regulation. Exceptions could be made if it was shown that the benefits of using the pesticide outweigh the potential adverse effects and that no preferable alternative is available. Additional exceptions in the cases of human and animal health, emergency situations, and in the instance of controlled experimentation of limited scope, were provided for in the regulations. Three exceptions were made by the Administrator during the term of the Interim Regulations: one for the AID contribution to the

Sahel Relief Operation and two for the use of pesticides in country projects in Liberia and Bolivia.

In May of 1978, the Environmental Procedures of Regulation 16 were amended to add supplemental procedures for in-depth evaluation of proposed AID projects involving assistance for the procurement or use, or both, of pesticides and to remove pesticides from eligibility in the Commodity Import Program with certain stated exceptions.

These procedures specify that any proposed project which includes the supply or use of pesticides must be subjected to an Initial Environmental Examination (IEE) prior to Agency approval. The examination is conducted to determine whether the use may result in significant environmental impact. Among the factors included in the examination are registration status of the pesticide(s), basis for selection, extent of involvement in an integrated pest management program, method of application, toxicological hazards, effectiveness of the proposed pesticide(s), compatibility with the ecosystem, conditions of use, alternative methods of control, ability of requesting country to regulate the pesticide, provisions available for training of applicators, and provisions for monitoring the pesticide. Other factors deemed necessary for the specific project may also be included.

Depending on the registration status of the proposed pesticide, various alternatives must be followed. Where the pesticide is registered by USEPA for the same or similar use, without restriction, no further action is required if the IEE indicates that a potentially unreasonable risk is not likely to arise from the pesticide use. When the proposed pesticide is registered for the same or similar use, but is restricted in use by USEPA, the IEE will also include evaluation of the user hazards and incorporate

provisions for making the recipient government aware of such hazards. In addition, specific provision will be made in the project for the training of persons using restricted use pesticides. Under these conditions a Negative Threshold Decision (TD) is recommended. If assistance is to be provided for the procurement or use of any pesticide other than one registered for general use, or one registered for restricted use on the basis of user hazard, the factors identified above will be incorporated in either an Environmental Assessment (EA), or an Environmental Impact Statement (EIS), as appropriate. Other factors which must be considered in EA's or EIS's are set forth in the relevant sections of the Environmental Procedures.

CONSULTANT SERVICES

The UC/AID/PM Project provided short-term consultants at the request of many overseas missions to assist with pest and pesticide management planning for projects. This work was undertaken with a view to avoid hazards to pesticide applicators and the environment by ensuring that appropriate pesticides are safely and judiciously used within an integrated pest management framework, thus minimizing dependence on pesticides in favor of cultural and biological methods of pest control.

These assignments typically included a survey of current pest problems and pest control measures, assistance in designing and implementing an IPM approach to field pest problems, and technical advice on choice of the proper chemicals, formulations and application technology, and the detection and measurement of pesticide residues in environmental media. This information with an evaluation of the environmental impact of the proposed measures was incorporated by project consultants into required documents -- IEE's, EA's,

EIS's -- prepared for project papers and/or Mission personnel. UC/AID/PM Project consultants were increasingly included on project design teams, thus insuring environmental acceptablility of the planned projects. In addition, consultants occasionally designed required programs of applied pest management research within a project framework and conducted negotiations with host country agricultural officials.

A steadily increasing number of overseas Missions became aware of UC/AID/PM Project consultant services, and requested technical assistance with the design of local projects through AID/Washington. Consultant visits during the period 1978-80 follow.

Bolivia

The USAID Mission/La Paz requested assistance concerning the use of fenitrothion on coffee, and the design of appropriate test protocol and sampling procedures to assure adequacy of a data base for the establishment of a U. S. tolerance for this pesticide. A specialist from the Chemistry Branch and Registration, Environmental Protection Agency, was sponsored by UC/AID/PM to respond to this request.

A seccond visit to Bolivia involved further consultation with the Mission and the Government of Bolivia concerning a review of the Bolivia Title III Program, Plant Quarantine and Pesticide Control. At the same time plant quarantine facility plans were reviewed and advice provided on current AID regulations regarding the use of particular pesticides. An Environmental Assessment was prepared.

Lesotho

Conferences were held with the Lesotho Ministries of Agriculture and Health and the Tropical Pest Institute, and other officials concerned

with the supply and use of pesticides. The current pest and disease control programs for maize, sorghum, wheat, beans and peas were reviewed to identify the most appropriate pesticides to be used in the context of an overall integrated pest management program, and to prepare an appropriate evaluation as required by AID's Environmental Procedures. An EA was prepared for use by the Lesotho Ministry of Agriculture and the Produce Marketing Corporation of Lesotho with respect to their funding by USAID.

Niger and Tunisia

A Project specialist travelled to Niger to review with the USAID Mission and appropriate representatives of the Government of Niger the use and supply of pesticides for use on sorghum, millet and cowpeas. Subsequently, he visited the USAID Mission and the Government of Tunisia to assist in analyzing and identifying the potential effect and environmental impact of chemical pesticides proposed for use by small farmers, with major emphasis on herbicides. In both countries the current pest and disease control programs for the crops of small farmers were reviewed in order to identify the most appropriate pesticides to be used in the context of an overall integrated pest management program, and an appropriate evaluation was prepared as required by AID's Environmental Procedures.

Honduras

Consultations were held with the USAID Mission/Tegucigalpa concerning pesticides requested for controlled use in a Pilot Project, Crop Substitution Program, and specifically for use on sorghum and soya against locusts, leaf-rollers, borers, and stink bugs.

Senegal

At the request of USAID/Senegal a consultant was recruited to partic-

ipate in a team activity to prepare a risk/benefit assessment of proposed pesticide use in both the on-going and re-designed USAID-funded Sahel Food Crop Protection Project, in preparation for Phase II of the activity.

Panama

Two trips were made to Panama, the first to conduct a pesticide analysis relative to Regulation 16 in the "Community Gardens" component of the Panama-Rural Health Delivery Systems Project. The second involved an Environmental Assessment of the use of pesticides in an AID-supported research project at the Instituto de Investigación Agropecuaria de Panama.

Guatemala

Consultations were held with the USAID Mission and the Government of Guatemala concerning the need for an Environmental Assessment in connection with the use of pesticides in a small farmer diversification assistance project, and to assist in the preparation of such an assessment, if necessary.

Africa: Kenya, Ivory Coast, Upper Volta, Niger, and Liberia

A UC/AID/PM Project specialist completed a two-month trip to Africa during which he visited USAID Missions in Kenya, Ivory Coast, Liberia, Guinea and Niger to review pesticide management problems. An Environmental Assessment of pesticide use in the Nimba Rural Technology Project, Nimba County, Liberia, was prepared. This trip was especially important in providing opportunities for new and continuing contacts with African specialists in pest management.

Ghana

A UC/AID/PM Project specialist travelled to Ghana as a member of the design team for Phase II of the Managed Input in Delivery of Agricultural

Services Project (MIDAS). Project activities were reviewed, and two IEE's prepared: one for the ongoing MIDAS Phase I, to facilitate the project's request for pesticides required prior to its termination; and one for MIDAS Phase II, identifying all reasonably foreseeable impacts of proposed project activities on the natural and human environment.

Fiji, Tonga, and Samoa

An extensive trip to the South Pacific to review the proposed use of pesticides in AID projects was sponsored by the South Pacific Regional Development Office. Assistance was provided to the Regional Office in surveying crop protection activities and helping with the preparation of an IEE of proposed pesticide use.

Somalia and Kenya

An EA of proposed pesticide use in the AID project "Agricultural Extension Training and Research" was prepared. Meetings were held with personnel of USAID/Mogadishu, the Ministries of Health and Agriculture, chemical companies and the Bonka Agriculture Training School concerning local pesticide management practices. Serious problems were identified involving use of inappropriate pesticides, pesticide storage and deterioration, and lack of personnel trained in proper pesticide application and management.

Trinidad

At the request of USAID/Barbados for assistance, a UC/AID/PM Project specialist participated in the first workshop of the USAID-financed project, "Small Farm Multiple Cropping Systems Research," held in Port-of-Spain. The workshop was to review programs and discuss plans for the project being developed in several CARDI-member countries in The Caribbean

area. Pesticides proposed for use in the project were examined, particularly with reference to requirements under Regulation 16. A report of activities in the workshop at Port-of-Spain was later submitted to USAID/Barbados, with guidelines for use of pesticides in the project.

The Sudan

A team of two specialists travelled to The Sudan as members of a design team for the proposed USAID project "Surveillance System for Schistosomiasis Control." The team conferred with Sudanese government officials, staff of the Khartoum University Institute of Tropical Medicine, and other concerned parties in order to develop the project's plan of operation. An IEE of proposed project activities was prepared, with special reference to research on biological control agents and chemical molluscicides as methods of controlling populations of schistosome-bearing snails.

Niger

The Project provided a specialist to join a design team for Phase II of the Niamey Department Development Project (NDD), an integrated rural development project funded by USAID and the Government of Niger. Activities of this consultant included: survey of crop pest problems, plant protection activities, and pesticide use patterns in Niger and in Phase I of the NDD; identification of appropriate pesticides for use in project extension programs; preparation of the IEE of proposed project activities; development of a proposal for submission to the Niger Government concerning project design changes necessary to bring project pesticide use into accord with USAID regulations; and the development of guidelines for an applied pesticides research program within the project framework.

Paraguay

A review was held on an existing list of pesticides proposed for application on research plots and small farms and advice provided to USAID/ Paraguay on which of the pesticides met eligibility conditions defined under Regulation 16. The effectiveness and safety factors were evaluated in pesticide application procedures and equipment used at the Instituto Agronomico Nacional and on farms involved with the Central Cooperativa Nacional horticultural production project. This consultation resulted in a written report as well as a guide on pesticides and pest management which could serve as the foundation for future short courses for small farmers.

Nepal

The USAID Mission in Kathmandu, Nepal, requested assistance in the review of Government of Nepal pesticide recommendations and practices, particularly in connection with the use of BHC in maize mini-kits distributed for farmer field trails of new recommended varieties. An Initial Environmental Examination and Risk/Benefit Analysis and Recommended Threshold Decision resulted from this assignment.

PROJECT PUBLICATIONS

General

The majority of UC/AID/PM publications have resulted from the reports of the multidisciplinary study teams and publication of the proceedings of the pesticide management seminar/workshops. Additional documents have been produced as a result of special studies performed by the Project, such as an investigation of information systems for alternative methods of pest control, an assessment of crop losses in rice, an evaluation

of pest management and pesticide management problems in the Arab Republic of Egypt, etc. A complete list of UC/AID/AM publications is given in Appendix I.

Publications of continuing general interest to international integrated pest management personnel are described below.

Periodical Newsletter

In order to communicate the activities of the project to interested persons around the world, a newsletter, Pest Management News, was developed. The first issue was published in September 1975, and succeeding issues have generally appeared on a quarterly basis. Articles in the newsletter concern pest management problems and programs, pesticide management and other items of interest to plant protection specialists throughout the world. Over 3,000 persons receive this newsletter, sixty percent of whom are in developing countries. A Spanish edition has been available since October 1978.

List of International Pest Management Conferences

The project prepared lists of international conferences related to pest management. Such lists are a valuable document to LDC scientists in planning for their participation in such meetings. The list is revised and updated every three months, and each issue mailed to a selected number of interested persons. The latest list produced by the UC/AID/PM Project in July 1980 noted conferences spanning the years 1980-83.

List of References on Plant Protection

In 1974, the project prepared a list of reference books in the plant protection sciences. The list of books, published in English, included those considered to be an important part of a plant protection laboratory, particularly where a facility may be isolated from a major laboratory. It

includes publications in entomology, plant pathology, nematology, weed science, and vertebrate pests.

Acronym List

In the process of dealing with the numerous organizations in the United States and worldwide, the project management has compiled a long list of acronyms. In order to have the list for ready reference, the project prepared a list of 391 acronyms with the full names of the organizations represented by the acronyms. The list was published in 1981.

INTERNATIONAL PLANT PROTECTION LIBRARY

The UC/AID Pest Management Project's International Plant Protection Library was developed to provide background support for Project activities in the developing world. Consistent with Project concerns, the library contains materials emphasizing international crop protection problems, with attention to the developing countries of Africa, South East Asia and Latin America. To this purpose it also includes materials relating to the field of crop protection in general.

The library covers the subject areas of integrated pest management, pesticides and related problems, agricultural problems and crops of the developing world, development assistance and economic aid, and general information in the fields of biology, botany, ecology, entomology and plant pathology. Catalogued holdings include books, periodicals, newspapers, reprints, governmental documents, conference and seminar proceedings, technical reports, general travel information and miscellaneous references. A special feature is an up-to-date clipping file of relevant newspaper and magazine articles.

The library is available to Project personnel, those involved in Project activities and university faculty and graduate students; it provides very limited services to the general public on a request basis only. The librarian is available to provide information requested by telephone or in person, interlibrary information search service within the University of California system, and xeroxing service of library materials.

UC/AID Pest Management and Related Environmental Protection Project Publications

1. Adkisson, P. L., et al., 1976. A Special Report on Pest Management and Pesticide Management in the Arab Republic of Egypt. Observations made during a UC/Egypt Colloquium on Pest Management, Cairo, Egypt, October 25-31, 1975. UC/AID/PM Special Report.

2. Anonymous, 1973. Progress Report of the UC/AID Pest Management and Related Environmental Matters Project. (July 1, 1972 to January 15, 1973).

3. Anonymous, 1974. Management of Pesticides and Protection of the Environment. A Report of a Seminar held in San Salvador, El Salvador, December 3-7, 1973. Sponsored jointly by UC/AID/PM, Ministries of Agriculture and Livestock, Public Health and Social Welfare, USAID Mission, and Pan American Health Organization.

4. Anonymous, 1974. A Report on a Seminar Workshop and Training in Pesticide Management. Proceedings of these activities held at Jakarta, Indonesia, July 8 - August 3, 1974. Sponsored jointly by UC/AID/PM, Departments of Health, Agriculture and Manpower, Indonesia, FAO, WHO, and the local pesticide industry.

5. Anonymous, 1975. Annual Report, UC/AID Pest Management and Related Environmental Protection Project (1971-1975).

6. Anonymous, 1975. A Report on a Seminar and Workshop in Pesticide Management held in Manila, Philippines, February 10-15, 1975. Sponsored jointly by UC/AID/PM, USAID/Manila, the Bureau of Plant Industry, Philippines, and the local pesticide industry.

7. Anonymous, 1976. The Agromedical Approach to Pesticide Management. A compilation of papers presented at previous UC/AID Pesticide Management Seminar/Workshops. Also in Spanish.

8. Anonymous, 1977. Annual Report, UC/AID Pest Management and Related Environmental Protection Project (1975-1976).

9. Anonymous, 1977. A Report on a Seminar/Workshop in Pesticide Management. Proceedings of these activities held at the University of Alexandria, Alexandria, Arab Republic of Egypt, March 5-10, 1977. Sponsored jointly by UC/AID/PM, the University of Alexandria, Ministry of Agriculture, Egypt, and USAID/Cairo.

10. Anonymous, 1977. Final Report on the First Regional Seminar on the Use and Management of Pesticides in Central America, "Una Aproximación Agro-Médica al Uso y Manejo de Plaguicidas," held in Guatemala City, Guatemala, February 2-4, 1976. Sponsored jointly by UC/AID/PM, USAID (ROCAP), and ICAITI. Also in Spanish.

11. Anonymous, 1977. Coffee Rust, Hemileia vastatrix. A Supplemental Report, prepared by the UC/AID Medfly Multidisciplinary Study Team, May 1977.

12. Anonymous, 1978. General Principles of Integrated Pest and Disease Control with emphasis on Maize and Soybeans. Compilation of lectures presented during a Short Course on Integrated Pest Control held in La Molina, Lima, Peru from April 17 - May 25, 1978 under the sponsorship of the UC/AID/PM Project, USAID/Lima, and the Ministry of Food and Agriculture. Also in Spanish.

13. Anonymous, 1978. Summary of Activities for 1977 of the UC/AID Project in Pest Management and Related Environmental Protection.

14. Anonymous, 1979. Annual Report, UC/AID Pest Mangagement and Related Environmental Protection Project. (1976-1977).

15. Anonymous, 1979. Integrated Pest Control for Small Farmer Cropping Systems. Compilation of lectures and country reports presented during a Short Course on Integrated Control held in Turrialba, Costa Rica, from August 27 - September 21, 1979 under the sponsorship of the UC/AID/PM Project, CATIE, OIRSA. In Spanish only. Three volumes.

16. Anonymous, 1979. Proceedings of the Seminar on Crop Protection, Pesticides and Food Crops. "Compte rendu de Seminaire sur la Protection des Vegetaux, Emploi des Pesticides sur les Cultures Vivrieres." Sponsored by the University of California and USAID, held in Dakar, Senegal, February 12-16, 1979. French and English editions.

17. Anonymous, 1979. Short Course in Integrated Control for Irrigated Rice in South and Southeast Asia. Compilation of lectures and country reports presented during a Short Course on Integrated Control held in Maligaya, Philippines, from October 16 - November 18, 1978, under the sponsorship of the UC/AID/PM Project, FAO, and BPI, in cooperation with IRRI, NCPC/UPBL, and PGCPP.

18. Anonymous, 1979. Regional Seminar on the Use and Management of Pesticides in Central America. Proceedings of a Seminar/Workshop held in Guatemala City, Guatemala, June 26-30, 1978. Sponsored jointly by UC/AID/PM Project, ICAITI, CATIE, PAHO, INCAP, BCEI. Also in Spanish.

19. Anonymous, 1980. International Short Course in Host Plant Resistance. Compilation of lectures presented during a Short Course on Host Plant Resistance held in College Station, Texas, from July 23 - August 3, 1979, under the sponsorship of the UC/AID/PM Project and Texas A&M University.

20. Anonymous. Acronym List of International Organizations Related to Agriculture, Economic Development and Pest Management.

21. Anonymous. International Conferences Related to Pest Mangement. Meetings list compiled and issued quarterly by the UC/AID Pest Management and Related Environmental Protection Project.

22. Anonymous. Pest Management Newletter. Periodic newsletter edited and issued by the UC/AID Pest Management and Related Environmental Protection Project.

23. Apple, J. Lawrence and Smith, Ray F., 1972. A Preliminary Study of Crop Protection Problems in Selected Latin American Countries. UC/AID/PM Preliminary Report.

24. Barr, Barbara A., Koehler, Carlton, S., and Smith, Ray F., 1975. Crop Losses - Rice: Field Losses to Insects, Diseases, Weeds and Other Pests. UC/AID/PM Special Report.

25. Bottrell, D. G., Huffaker, C. B., and Smith, Ray F., 1976. Information Systems for Alternative Methods of Pest Control with emphasis on problems and needs of crop protection specialists in developing countries. UC/AID/PM Special Report.

26. Caltagirone, L. E., et al., 1972. The Crop Protection Situation in Guatemala, Honduras, Nicaragua, Costa Rica, Panama and Guyana. UC/AID/PM Interdisciplinary Study Team Report.

27. Cavin, George E., et al., 1972. Crop Protection in the Mediterranean Basin. UC/AID/PM Interdisciplinary Study Team Report.

28. Davies, John et al, 1972. International Survey on Pesticide Use. UC/AID/PM Panel on Pesticides.

29. Day, Boysie, E., 1974. Pest Management and the Efficient Use and Safe Handling of Pesticides in South Vietnam. UC/AID/PM Special Report.

30. Echandi, Eddie, et al., 1972. Crop Protection in Brazil, Uruguay, Bolivia, Ecuador and the Dominican Republic. UC/AID/PM Interdisciplinary Study Team Report.

31. Glass, Edward H., et al., 1971. Plant Protection Problems in Southeast Asia. UC/AID/PM Interdisciplinary Study Team Report.

32. Glass, Edward H., 1977. UC/AID Pest Management Training Workshop for Entomologists. Report of the workshop for entomologists from developing countries organized by Cornell University and North Carolina State University under sponsorship of the UC/AID/PM Project and held from July 18 - August 27, 1976.

33. Koehler, C. S., et al., 1972. Plant Protection in Turkey, Iran, Afghanistan, and Pakistan. UC/AID/PM Interdisciplinary Study Team Report.

34. Koehler, C. S., and Smith, Ray F., 1974. Reference Books in the Plant Protection Sciences. UC/AID/PM Special Compilation.

35. Mann, Jon B., 1978. Manual for Training in Pesticide Analysis. University of Miami, subcontract with the University of California/ USAID.

36. Mitchell, W. C., et al., 1977. The Mediterranean Fruit Fly and its Economic Impact on Central American Countries and Panama. UC/AID Interdisciplinary Study Team Report.

37. Sasser, J. N., et al., 1972. Crop Protection in Senegal, Niger, Mali, Ghana, Nigeria, Kenya, Tanzania and Ethiopia. UC/AID/PM Interdisciplinary Study Team Report.

38. Schaefers, George A., Lockhart, Benham, E., and Georghiou, George P., 1980. La Defense des Cultures en Tunisie. UC/AID/PM and Related Environmental Protection Project. (Trip Report).

39. Sequeira, Luis and Kelman, Arthur, editors, 1976. Proceedings of the First International Planning Conference and Workshop on the Ecology and Control of Bacterial Wilt Caused by Pseudomonas Solanacearum, Raleigh, North Carolina, July 18-24, 1976. Sponsored jointly by the University of Wisconsin-Madison, North Carolina State University-Raleigh, and the International Society for Plant Pathology.

40. Smith, J. W. and Lionel, Richard, 1978. Potential Pest Management Strategies for Haitian Agriculture -- Developing the Ecological Base.

41. Smith, Ray, Editor, 1974. Report on the Sahel Crop Pest Management Conference. Proceedings of an AID-sponsored conference held in Washington, D. C., December 11-12, 1974. Also in French.

42. von Rümker, R., and Horay, F., 1972. Pesticide Manual; Part I: Safe Handling and Use of Pesticides, Part II: Basic Information on 35 Pesticide Chemicals and Part III: Specifications. Department of State and AID Special Manual.

    Freed, Virgil, 1976. Pesticide Manual; Part I: Safe Handling and Use of Pesticides (Chapter on Handling, Transportation and Storage of Pesticides - replacing chapter on same subject appearing in the 1972 edition of Manual.) Department of State and AID Special Manual.

43. Wilcoxson, R. D., et al., 1975. Plant Protection in Bangladesh. UC/AID/PM Interdisciplinary Study Team Report.

44. Yates, W. E., et al., 1974. Analysis of Pesticide Use in Pakistan. UC/AID/PM Interdisciplinary Study Team Report.

45. Zimdahl, R. L., editor, 1973. Weed Science in the Developing Countries of the World. UC/AID/PM Summary Report.

UC/AID Pest Management and Related Environmental Protection Project Multidisciplinary Study Teams

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