PLANNING STUDY FOR INTEGRATED CROP PROTECTION RESEARCH IN GUATEMALA, COSTA RICA, COLOMBIA, AND PERU

INTEGRATED CROP PROTECTION

A SITE-VISIT TEAM REPORT

Contract AID/DSAN-G-0203

United States Agency for International Development

and

International Programs in Agriculture

PURDUE UNIVERSITY

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A Multi-disciplinary Integrated Crop Protection Site Team Report for Latin America, emphasizing Guatemala, Costa Rica, Colombia, and Peru. Part of a Title XII Planning Grant to Purdue University.

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RECOMMENDATIONS

The Latin American Site Team, after considerable investigation and thought, recommends the following for Title XII ICP Planning Staff:

1. That a primary country site for a Title XII CRSP be established in Peru. At this site the following should be considered:
   a. That this project be comprehensive and act as a model to study the way ICP programs might be initiated and maintained, and how the transfer of technology can best be accomplished. Research on crop-crop interactions and how they affect pest populations should be a definite subgoal of the project.
   b. That the project be consistent with AID's efforts to use appropriate collaborative institutions to implement agricultural research, extension, and education.
   c. That such a program should complement the AID-DLC/P-2278 and AID/LAC/P-042 projects and should be phased into and coordinated with these larger projects in the selva alta of Peru.
   d. That crop protection students from UNA and other Peru universities should be given the opportunity to participate in the ICP program as scouts during vacation times, thus giving them practical experience in ICP and at the same time, providing the work force to establish an ICP program in the selva alta. A further spin-off will be the fact that these students will carry with them the ideas of ICP and initiate new ICP programs in other parts of Peru.
   e. That the small farming research methodology be used to test the small farm production, economics and social feasibility of alternative ICP practices within the limited resource, production technology, institutional, social and infrastructure constraints of the small farmers.
   f. That any potentially successful ICP program must be a coordinated effort involving plant pathologists, entomologists, nematologists, weed scientists, system analysts, agricultural economists, crop scientists, and sociologists/anthropologists. It must include

researchers, extension specialists, and educators. And, inevitably, it must take into account agronomic practices, meteorological phenomena, and edaphic factors.

g. That appropriate funds be made available to be used in the implementation of ICP research results through a reliable delivery system. Extension activities are directly tied to the success and ultimate goal of benefiting the small farmer.

2. That a secondary site be established in Colombia. At this site the following should be considered:
   a. That a restricted program in virus etiology and epidemiology be undertaken.
   b. That this program involve the major small farm crops in Colombia, especially corn, beans, potato, grain legumes and their crop associates.
   c. That such a program should involve virology, entomology, and weed science, since insects are almost always vectors of these viruses, and weeds are often alternate hosts of the viruses or the vectors, or both. This also includes alternate crops, especially of viruses, but to a limited degree, also of the vectors.
   d. That this project could transcend country borders by involving virologists and vector entomologists from, for instance, Costa Rica and Peru.
3. That basic identification/diagnostic services are needed for large segments of Latin America. While most plant pathological, vertebrate, and weed problems are readily diagnosed, viruses, insects and nematodes are not. Because the first step to the solution of any pest problem is its proper identification, we feel that centers of expertise should be set up in Latin America, one involving CATIE and the University of Costa Rica, serving all of Central America, and one at UNA, La Molina, serving the Andean countries. These centers should include tools necessary to identify nematodes, viruses and insects.
4. That basic ICP literature be purchased and deposited with collaborative in-country institutions.
5. That CATIE/University of Costa Rica serve as a regional postgraduate training center in ICP for Central America, and that UNA-La Molina serve a similar function for the Andean Pact countries. ICA-Tibaitata is another possibility as a regional postgraduate training center.

6. The university and national research and extension scientists have made considerable progress in developing new agricultural technology; however, only a small amount of this is being used by the small farmer.
7. More agricultural economists and sociologists must be employed at national institutions to help direct cropping systems research and the role of ICP in it.
8. That the Title XII programs cooperate with the International Agricultural Research Centers (IARC) by disseminating and testing potentially pest resistant material within the areas of the programs and that the IARCs act as one source of short and long-term training centers for in-country student programs.

LIST OF ACRONYMS

AID	Agency for International Development, USA
BID	Banco Interamericano de Desarrollo
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza
CGIAR	Consultative Group on International Agricultural Research
CIAT	Centro Internacional de Agricultura Tropical
CICIU	Centro de Introducción y Cría de Insectos Útiles, INIA, Peru
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo
CIP	Centro Internacional de la Papa
CRSP	Collaborative Research Support Program
DRI	Programa de Desarrollo Rural Integrado
FFRC	Forestry and Fauna Research Center, Peru
IADS	International Agricultural Development Service
IARC	International Agricultural Research Center
ICA	Instituto Colombiano de Agropecuario
ICAITI	Instituto Centroamericano de Investigación y Tecnología Industrial
ICP	Integrated Crop Protection
ICTA	Instituto de Ciencia y Tecnologia Agricolas
IICA	Instituto Interamericano de Ciencias Agricolas
INIA	Instituto Nacional de Investigación Agraria
INTSOY	International Soybean Program
MAF	Ministry of Agriculture and Foods, Peru
MAG	Ministero de Agricultura y Ganadería, Costa Rica
OIRSA	Organismo Internacional Regional de Sanidad Agropecuaria
ROCAP	Regional Office for Central American Projects, USAID
UC/AID	University of California at Berkeley/AID Pest Management Project
UCR	Universidad de Costa Rica
UNA	Universidad Nacional Agrária, La Molina, Peru
USAID	United States Agency for International Development
USDA	United States Department of Agriculture

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It is difficult to express the gratitude we feel for the many wonderful contacts and happenings we made and experienced during this site visit. We sincerely thank all of those we contacted, whether a field hand in the Callejon de Huaylas or the Director General of CIP for their time, effort, and unending help during the course of this study. Many of these people are listed in Appendix A; a few are not. We wish to inform them all that their help was very much appreciated and that they have not been forgotten.

Dr. Fausto Cisneros worked as a member of the team in Peru. For three weeks, he took time from his busy schedule to accompany us on all trips, to help suggest places to visit, people to contact, and ways to express results. To him we offer heartfelt thanks. To Ing. Manuel Delgado and Alfanso Cerrate, who also accompanied us on some of our trips in Peru, we express our deep gratitude. We are extremely appreciative to David Schaer for helping us with contacts in Bogota, to John Nickel for treating us so hospitably in Cali, to Aart von Schoonhoven and Reinhardt Howeler for an informative and memorable field trip on their day off, to Ed Trujillo for guiding us through the offices and fields of Guatemala, to Joe Saunders, Raul Moreno, Andrew King, Phil Shannon, Myron Shenk, and Luis Navarro, who guided us through the pest management scene at CATIE; to all of these people we offer our thanks.

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To our wives we owe much for their patience and understanding.

INTRODUCTION

Background

A preliminary study of crop protection problems in Latin America was conducted in 1972. The resulting report (Apple and Smith 1972) greatly influenced the direction and focus of integrated crop protection (ICP) in that region during the 1970's. That same year, multidisciplinary teams reported on the ICP situation in Central America (Caltagirone et al. 1972) and in parts of South America (Echandi et al. 1972). These and related activities in ICP were supported by USAID through a contract to the University of California at Berkeley under a program entitled the UC/AID Pest Management and Related Environmental Protection Project. In Latin America this project has focused on a series of short courses, seminars, and workshops aimed at two distinct but related themes: 1) pesticide safety and environmental protection and 2) concepts and practices of integrated crop protection. Three such seminars illustrate the first theme (Ministerio de Agricultura y Ganaderia, El Salvador, Ministerio de Salud Publica y Asistencia Social, USAID Mission San Salvador, Pan American Health Organization, and UC/AID Pest Management Project 1973; Ministerio de Agricultura, Colombia, Ministerio de Salud, Instituto Colombiano Agropecuario, y la Universidad de California y AID 1978, with an accompanying volume on Colombia legislation regulating usage of agricultural chemical inputs, Morales and Gomes 1978; and ICAITI 1978). The proceedings of two short courses, one held at La Molina, Peru in 1978 (Cisneros et al. 1978) and another held at Turrialba, Costa Rica (CATIE, UC/AID Pest Management Project, and OIRSA 1979) are examples of the latter.

The Agency for International Development-Oregon State University program in weed systems technical assistance and research has had a strong Latin American focus throughout its 14-year history. On-site projects have been successfully conducted in predominantly small farm areas of Colombia, Ecuador, Panama, El Salvador, Brazil, and, currently, in Costa Rica.

Research has emphasized an integrated approach to improved, but realistic weed control practices, the latter in terms of biological and socio-economic parameters. Mechanical, cultural, and chemical resources are surveyed and, where feasible, blended into systems approaches that take into account factor constraints and small farmer heritage, culture, and physical situation.

Graduate students from 18 countries have conducted their advance studies in weed science at OSU. Several now hold pivotal research and teaching positions in

Latin American nations. Others have contributed to the two-way flow of technical information.

Project staff members assigned to Latin American posts are fluent in Spanish. The Costa Rican effort, conducted in conjunction with AID's Regional Office for Central American Programs, headquarters at Turrialba, carries regional responsibility. As a case in point, the senior project agronomist at Turrialba, at the request of USAID/Barbados, took a major role in conducting two 1-week short courses in the Caribbean recently.

In collaboration with CIAT, the project conceived and conducted a comprehensive, all-in-Spanish weed science short course at Cali, Colombia, in 1975. Numerous other shorter courses have been presented with various joint sponsors through Central and South America during the last decade. The project also assisted FAO to organize and conduct a short course in Argentina during October-November, 1979.

The International Agricultural Centers in the Latin American sector -- Centro Internacional de Mejoramiento Maiz y Trigo (CIMMYT), Centro Internacional de Agricultura Tropical (CIAT), and Centro Internacional de la Papa (CIP) -- have added greatly in the area of ICP through identification of germplasm with resistance or tolerance to various diseases, nematodes, and more recently insects. They all have maintained active breeding programs, many of which focus on incorporating resistant traits into agronomically desirable phenotypes. Activities at the International Agricultural Research Centers in small farm systems are being initiated. The International Agricultural Research Centers realize the need to work within the context of the total system; their approaches and contributions in this area were recently reviewed (CGIAR 1978).

The Centro Agronomic Tropical de Investigacion y Ensenanza (CATIE), supported mainly through USAID/ROCAP, has concentrated heavily on small farm systems in Central America and its direction and emphasis focus on ecological, economic and social constraints in small farms. ICP has played an important role in the understanding of small farm constraints and has contributed to their reasonable and economical approaches and solutions.

Thus, during the past decade, USAID, through the University of California at Berkeley and Oregon State University, and through various international, regional and national institutions, has helped lay the foundation for ICP throughout much of Latin America. It now seems opportune to build on this foundation in an organic and creative way, solidifying ICP as an integral, dynamic and indispensable element of the small farm cropping system.

Team Mission

The Latin American Site Team was charged with the following general mission: upon visiting countries in Latin America, in as much as data are available and time permits, gather information relevant to:

a) small farm cropping systems,
b) major limiting factors/production constraints surrounding these cropping systems,
c) major protection constraints, focusing on weeds, diseases, nematodes, insects and vertebrates,
d) organizations responsible for easing these constraints with a critique of their procedures,
e) socio-economic situation, stability, flexibility, resources and infrastructure within each country and institution to successfully carry out an integrated crop protection program,
f) priority areas within crop protection for the ICP/Title XII program with recommendations for ICP programs, and sites where these programs might most successfully be carried out.

Team Composition

Five experts in various areas of ICP were selected to participate on the Latin American Team:

Dr. Michael E. Irwin, leader, entomologist, University of Illinois;
Dr. James M. McGrann, agricultural economist, Texas A & M University;
Dr. Richard E. Stuckey, plant pathologist, University of Kentucky;
Dr. G. Fred Warren, weed scientist, Purdue University; and
Dr. Delmar E. Broersma, entomologist, Purdue University.

Dr. Broersma was sponsored by a Title XII strengthening grant to Purdue University and he concentrated heavily on technology transfer and delivery systems. While not officially part of the core team, he participated as a core member and contributed greatly to the success of the mission.

Sites Visited

The team visited Guatemala, Costa Rica, Colombia and Peru. Below is a list of the institutions visited while in each country (a detailed list of institutions and persons contacted accompanies this report -- Appendix A).

GUATEMALA (1 1/2 days)

Instituto de Ciencia y Technologia Agrocolas (ICTA)

USAID Mission/Guatemala

Regional Office for Central American Projects, AID (ROCAP)

COSTA RICA (4 days)

Centro Agronomico Tropical de Investigacion y Ensenanza (CATIE)

Instituto Interamericano de Ciencias Agricolas (IICA)

University of Costa Rica, College of Agriculture

USAID Mission/Costa Rica

COLOMBIA (6 days)

Departmento Nacional de Planeacion (DNP), Bogota

Instituto Colombiano Agropecuario (ICA)

Tibaitata Station, Bogota

Palmira Station, near Cali

Centro Internacional de Agricultura Tropical (CIAT)

PERU (14 days)

Ministerio de Agricultura y Alimentacion, (MAA), Lima, Cuzco, Lamayeque, Chiclayo, Tarapoto stations

Instituto Nacional de Investigacion Agraria, Lima, La Molina, Cuzco, Anta, Urubamba, Huaraz, Chiclayo (Vista Florida), Tarapoto (El Porvenir) stations

Universidad Nacional Agraria, La Molina and station in Callejon de Huaylas

Universidad Nacional Pedro Ruiz Gallo, Lambayeque

Universidad Nacional in Cuzco

USAID Mission/Peru

Centro Internacional de la Papa (CIP)

SMALL FARM SYSTEMS AND CROP PROTECTION PRACTICES IN LATIN AMERICA

Climatic and Geographic Characterization of Latin America

Latin America is a large and varied land mass encompassing part of North America and all of South America. It is characterized by a dominant, high range or several parallel ranges of mountains, often forming vast, high plateaus. To the east of these extend large expanses of low-lying plains such as the enormous Amazon basin that provides the world's largest area of equatorial climate of uniformly high temperatures, high rainfall over much of the year, high humidity and little wind. To the west of the central mountain ranges are generally more abrupt slopes extending to the Pacific Ocean. The area between southern Eucador and central Chile is a cool, often cloudy desert with very little rainfall. The massive uplifts creating the central spine are characterized by a more temperate climate with sharply denoted seasons of precipitation. The variation in precipitation is marked throughout Central and South America, and this parameter, more than temperature, determines cropping seasons.

Precipitation and topography, then, are key elements in the determination of crops and cropping systems throughout Latin America. Other important parameters include farm size, economic and social considerations such as food preference, prices, credits, transportation infrastructure, market availability, and irrigation. It seems important to first deal with the economic and social aspects of small farm systems, those aspects that largely act as overriding constraints, before describing in detail the small farm cropping systems in Latin America and the protection constraints surrounding them.

Economic and Social Aspects of Small Farm Systems in Latin America

Background. Nearly 8 million people lived on small farms in Central America (excluding Panama) in 1970 (SIENCA 1974) (Table 1); these people lived on more than a million small farms of less than 4 ha of land each. Colombia had nearly one million farms each of less than 20 ha (DRI). Poverty in Peru has remained overwhelming even after larger land holdings under individual ownership have been eliminated. Over 8 million people are currently living in poverty in urban slums and the sierra of Peru, and that means that more than half the total countries' population is poor and malnourished (AID January 1980).

Land area is only one of the parameters that describes the limited resource situation of the small farmer. Land differs a great deal in its realized and

Table 1. Rural population and total agricultural income by socio-economic strata (1970).

	Size of the farm					
	less than 4 ha		4 - 35 ha		more than 35 ha	
	N^o people (x 1000)	Total Income (million$)	N^o people (x 1000)	Total Income (million$)	N^o people (x 1000)	Total Income (million$)
Guatemala	3,044	107	515	67	96	134
El Salvador	1,844	61	235	75	57	120
Honduras	1,219	49	555	73	93	87
Nicaragua	697	70	305	42	211	53
Costa Rica	836	84	225	58	130	165
Central America	7,764	371	1,835	315	587	559

Source: SIECA. Perspectives para el desarrollo y la integracion de la agricultura en Centro America. Two volumes, Guatemala 1974.

potential production capacity. As can be observed in Table 2, cropped land varied between 0.2 and 0.4 ha per capita in the countries in Central America, Colombia and Peru (IADS 1977). Small farms are typically on the most marginal land while the more productive lands are used by larger farmers and contain mostly export and cash crops.

A large portion of the population of the countries considered are employed in agriculture (Table 2). The population in agriculture ranges from a low of 38% in Colombia and Panama to a high of 66% in Honduras. Most of the agricultural rural population live on small farms, these small farms are a major supplier of consumer food goods in most of the countries as well as the primary source of livelihood for millions.

The limited resource situation, unproductive technology, institutional and social constraints and limited infrastructure result in a very low small farm income. As a result of the persistent poverty situation and limited opportunity, especially for the landless poor in rural areas, there has been a rapid rural to urban migration. Urban population growth during the 1970-1976 period was estimated to be nearly 4 times the rural growth in Central America and even greater in Colombia and Peru (Table 3). In addition to the immense problem of rural proverty, there has been a growing problem of urban poverty and malnutrition. In most of the countries considered, increase in food demand was greater than total food production increase during the 1966-1977 period (CIAT 1980).

Improving the performance of the agricultural sector to raise the standard of living of the small farmers, reduce the rate of rural to urban migration, and to supply the food needs of the rapidly growing population is an enormous task. The present condition of social and political unrest in many of the countries emphasizes the urgency to respond to the need to improve the agricultural sector's performance.

Small Farm Constraints. To formulate a potential program that could improve the production performance of the small farmer, the constraints that limit present production must be identified. Only after these constraints are identified can a specific program be developed to reduce the influence the constraint has on the production performance on small farms. The major categories of small farm constraints faced in meeting subsistence rquirements and to generate cash income are: (1) limited resources, (2) production technology, (3) institutional and social constraints, and (4) infrastrucutre constraints (Fig. 1). One of the primary resource constraints identified with small farms is land resource and the lands' productive capacity in a very broad sense (topography, climatic, soils, etc.)

Table 2. Population, GNP, per capita, and per capita cropland in Central American Countries, Colombia and Peru.

	Total Population (1977) (million)	% Population in Agric. (1970)	GNP Per Capita (1974) (US$)	Cropped land Per Capita (Aug.1972-1974)
Guatemala	6.4	61	580	0.3
Nicaragua	2.3	49	670	0.4
Costa Rica	2.1	42	810	0.2
El Salvador	4.3	56	410	0.2
Honduras	3.3	66	340	0.3
Panama	1.8	42	1000	0.3
Colombia	25.0	38	500	0.2
Peru	17.0	45	740	0.2

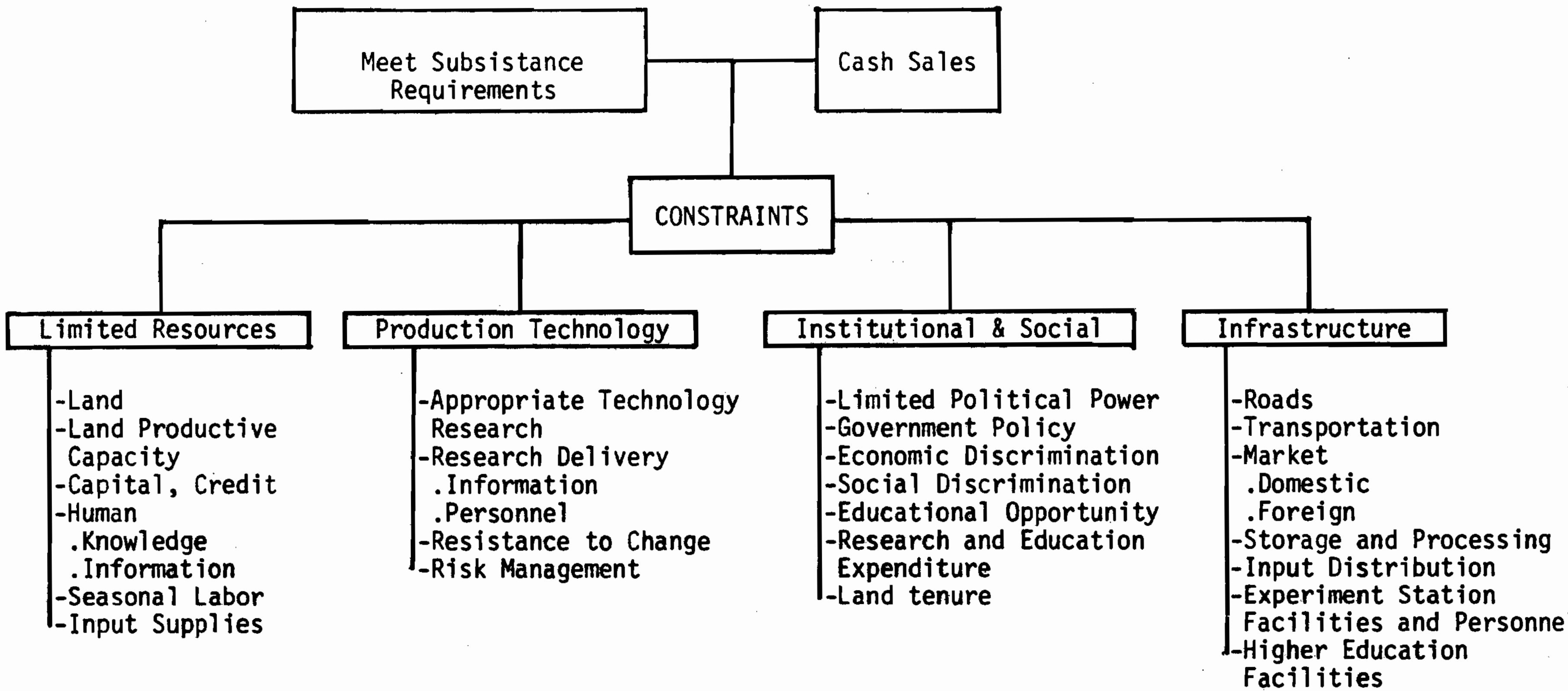
Source: IADS

Table 3. Growth rates of rural and urban population in Latin America during three periods, 1950-1960, 1960-1970, 1970-1976

	GROWTH RATES					
	1950-1960		1960-1970		1970-1976	
	RURAL	URBAN	RURAL	URBAN	RURAL	URBAN
MEXICO	1.52	4.88	1.85	4.81	1.79	4.66
CARIBBEAN	1.43	4.50	1.10	6.10	-1.06	5.90
Costa Rica	3.68	4.16	2.23	4.95	1.71	3.86
El Salvador	2.45	3.34	3.25	3.69	2.97	3.49
Guatemala	0.98	5.47	1.73	4.13	1.17	3.79
Honduras	2.42	6.18	3.11	4.14	-1.56	5.33
Nicaragua	1.48	4.08	1.67	4.50	0.66	4.20
Panama	2.03	4.39	2.10	4.66	1.58	3.98
CENTRAL AMERICA	2.53	3.20	2.06	4.86	1.09	4.00
Venezuela	-0.26	5.69	-0.82	4.92	0.92	2.48
Chile	0.13	3.68	-0.49	3.48	-3.21	2.41
Colombia	0.90	6.75	1.56	4.18	-2.20	4.47
Peru	-	-	0.05	5.12	0.90	4.60
ANDEAN COUNTRIES	0.85	5.22	0.83	4.41	0.75	3.25
Brazil	1.43	4.82	0.57	4.52	0.10	4.93
Paraguay	2.12	2.67	2.42	3.22	-	-
RIVER PLATE COUNTRIES	-1.36	3.52	-0.71	2.15	-0.34	1.63
LATIN AMERICA	1.14	4.84	0.89	4.16	0.91	3.71

Source: The 1950, 1960, and 1980 data on total, rural and urban populations were taken from Economic Research Service, Agriculture in the Americas: Statistical Data, F DCD Working Paper, U.S. Department of Agriculture, Washington, D.C., 1976, pp. 108 and 111. The 1976 data were taken from Inter-American Development Bank, Economic and Social Progress in Latin America 1976 Report, Washington, D.C., 1977, p. 391.

FIGURE 1: Small Farm Constraints



These constraints are interrelated and differ in the degree they influence production performance between farms and regions.

Small Farm Labor. Small farms typically have limited capital and land but have an abundant supply of labor. The large family size and associated high rates of population growth provide for an increasing problem of unemployment in rural areas. It must be recognized, however, that while annual unemployment occurs on most small farms, seasonal labor shortages particularly during planting, weeding and harvesting of a crop can be a constraint on production. This was noted in some areas of Colombia where coffee harvests coincided with small farm planting and harvesting activities.

Livestock Usage. On many of the small farms in Central America, a few scavenger chickens and hogs are the only livestock production activities. Production technology is generally poor and livestock production is low due primarily to nutritional problems associated with inadequate protein levels in feed. Oxen and donkeys are found on some farms but are used mostly for transportation of commodities to market and to haul production inputs.

In the areas visited in Colombia and Peru, in addition to scavenger livestock, many farmers use oxen for tillage. Forage production for the oxen becomes an important part of the cropping system. In the high altitude, cattle, sheep and llama enterprises are important production activities that graze land unsuitable for crop production.

Consideration should be given to identify appropriate ICP technology for the interaction between livestock and cropping production systems. Opportunities exist to improve the nutritional aspects of livestock feeding programs and, at the same time, to use the livestock enterprise to complement the cropping system in the forms of fertilizer, cash flow, animal power, food, and more efficient utilization of labor.

Small Farm Strategy. The inability to produce a socially acceptable income level is by definition the small farmers' problem. In addition, in many cases the nation's productive potential is not realized because productive resources are underutilized in the small farm sections of agriculture. The magnitude of individual constraints to productivity are variable among small farms and different regions of a country.

The small farmer must operate within existing constraints to: (1) survive in the short run and (2) in the longer run, improve his quality of life in the broadest sense.

For a given set of resources and production technology, the small farmer has been shown to be a very rational user of these resources. Given the limited resources, to significantly increase small farm income producing capability requires a change in production technology that either increases production or lowers per unit cost at the farm level. An expanding market that can absorb production increases must accompany this technological change. And this must occur without lowering net production prices.

Small farmers have also been shown to be very rational in their approach to risk management. With limited resources, the small farmer cannot afford to use high risk production systems. Normally, small farmers will combine annual with perennial crops, the latter being of less yield, but of less market risk. The small farmer will be particularly reluctant to adopt high input technology that will require cash flow imputs that place severe financial pressure on the farm business.

The sections that follow describe the cropping systems used by small farmers and reflect the strategy used in operating within the constraints and those preceived risks.

Small Farm Cropping Systems in Latin America

Of the many factors that lead to the establishment of cropping systems in Latin America, those of a socio-economic nature are, in some ways, most important for they are governed by infrastructure-related constraints (transportation, markets, pricing policy, etc.) and by the customs of peoples. Since crops can only be grown where their varied physical requirements are met, these socio-economic constraints form a decision-layer that is superimposed on the physical constraints. Thus, the physical setting (i.e. a specific environment) governs the crops from which cropping systems can be composed.

Part of any cropping systems approach is to first analyze existing information so that it can be used, among other purposes, to delineate agro-climatic zones to evaluate resource potentials, to assess present agroecosystems from a resource base and land use point of view, to identify target areas for system studies, and to identify pilot research sites. Agro-climatic zones are based on an environmental classification, and those need to take into consideration an understanding of what aspects of the environment are critical to the adoption of technology and of the size of changes in environmental conditions that need to be identified (CGIAR 1978).

One of the easiest ways to look at crops and their physical constraints is to review the crops that can be grown successfully in various climatic zones: cool, moderate, and warm. A hypothetical transect across Central America (Fig. 2) depicts the cropping systems grown according to topography (and therefore temperature) and proximity to the Atlantic and Pacific Oceans (i.e. rainfall) (Raul Moreno and Joseph Saunders, personal communication). In Colombia the principle crops grown in the cool zones are peas, garden vegetables, beans, corn, potato, barley and wheat; in the moderate climatic zones the principle crops are corn, cassava, garden vegetables, coffee, cacao, plantain, and beans; in the warm zones corn, garden vegetables, cassava, cotton, rice, sesame, sorghum, soybean, cacao, coconut, sugar cane, peanut, and tobacco are grown. The crops that form the garden vegetable category also differ among zones. Thus, onions grow well in the cool zones while squashes form part of the cropping system in the warm zones.

Another way of approaching cropping systems is to visualize the variety of ways crops can be grown in relation to one another, both spatially and temporally. CGIAR (1978) has defined terms used to describe various cropping systems (Table 4). Basically, these are single cropping systems, in which only one crop of a single species is grown on a plot of land in one year, and multiple cropping systems, in which more than one crop is grown on the same plot of land in one year. Multiple cropping systems can be divided into those in which crops are separated by time (double cropping, triple cropping), and those which are grown simultaneously on the same plot of land. Of those that occur simultaneously, there are intercropping (two or more crops in separate but proximal stands), row intercropping (two or more crops each in distinct rows), mixed intercropping (two or more crops intermingled with no distinct row arrangement), multi-story cropping (two or more crops of distinctly different height), and relay cropping (two or more crops grown in sequence in such a way that the ground is never without a crop). The latter term departs somewhat from the concept of the simultaneousness of crops (Fig. 3).

In Colombia, the major crops of the three climatic zones have been further categorized by how they are grown relative to one another within each zone (Alarcon _et al_. 1980). These are depicted in Table 5. What is immediately obvious is that some crops are grown in all zones and sometimes in several cropping patterns. For instance, corn is double cropped in the cool climate, but often intercropped or relay cropped in the moderate and warm climatic zones (Table 5).

Basically, small grains, cotton, soybean and sesame are single or double cropped. Beans, corn, peas and some garden vegetables often form a part of separate stand intercropping systems while some garden vegetables, broad bean

Figure 2. Hypothetical transact of Central America showing small farm crops and relative spacial placement. (Raul Moreno and Joseph Sanders, personal communication).

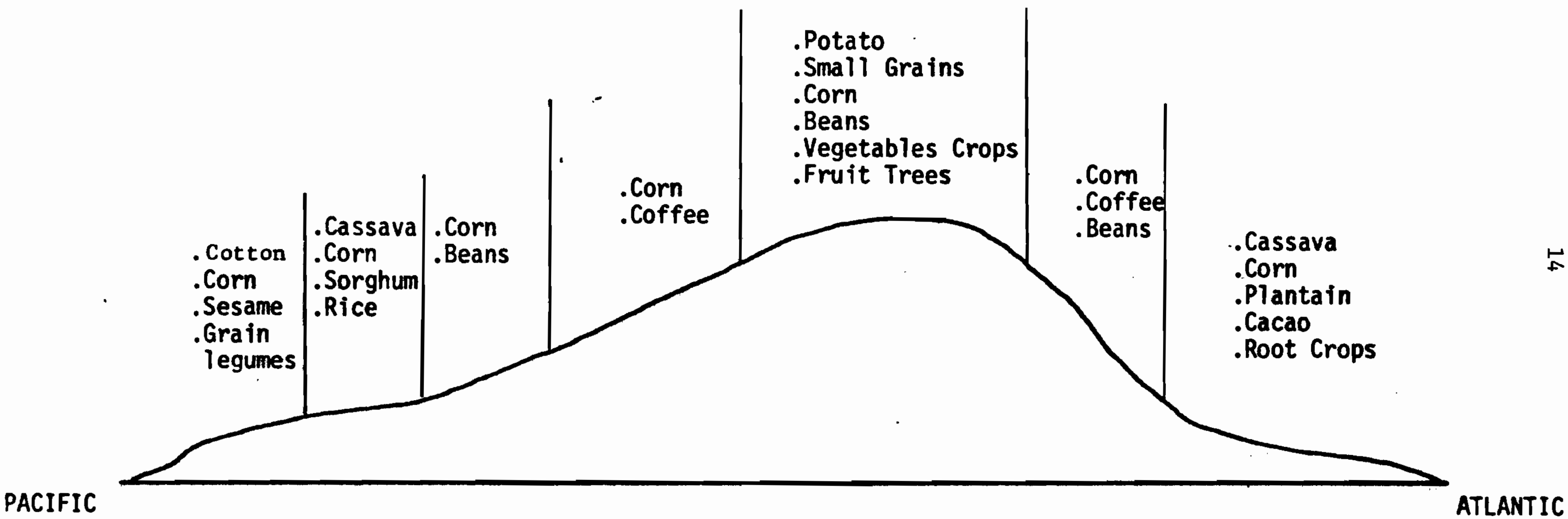


Table 4

CLASSIFICATION TERMS IN FSR RELATING TO CROP PRODUCTION SYSTEMS

A crop system or crop production system[1] comprises all components required for the production of a particular crop and the inter-relationships between them and the environment. These components include all the necessary physical and biological factors, as well as technology, labour and management.

Single cropping: growing only one crop on a plot of land within one year.

A multiple cropping system is a system in which more than one crop is grown on the same plot of land on one year. There are various multiple cropping possibilities in time and space. Some of the more important are:

(a) double cropping: growing two crops in sequence, seeding or transplanting one after the harvest of the other. Similarly triple cropping is the growing of three crops in sequence one after the other in one year.

(b) intercropping: growing two or more crops simultaneously in the same plot in different but proximate stands.

(c) row intercropping: growing two or more crops simultaneously in the same plot in distinct rows.

(d) mixed intercropping: growing two or more crops simultaneously intermingled in the same plot with no distinct row arrangement.

(e) relay intercropping or relay cropping: growing two or more crops in sequence, seeding or transplanting the succeeding one some weeks before the harvest of the preceding crop.

Strip cropping: growing two or more crops in distinct strips of several rows with each strip capable of independent cultivation.

Sole cropping: growing one crop (variety or species) alone in pure stands, either as a single crop or as a sequence of single crops within the year.

A crop rotation system implies a time sequence of crop systems, either sole or overlapped in phase, on the same area. While a crop rotation system implies a regular cyclical pattern over time (often involving a cycle of more than a year) this need not be so with multiple cropping.

The term cropping system refers to the set of crop systems making up the cropping activities of a farm system. If the farm also has non-crop activities, then the cropping system is a subsystem of the farm system.

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[1] Analogously, we may refer to a farm's livestock system, or livestock production system, for example its beef system.

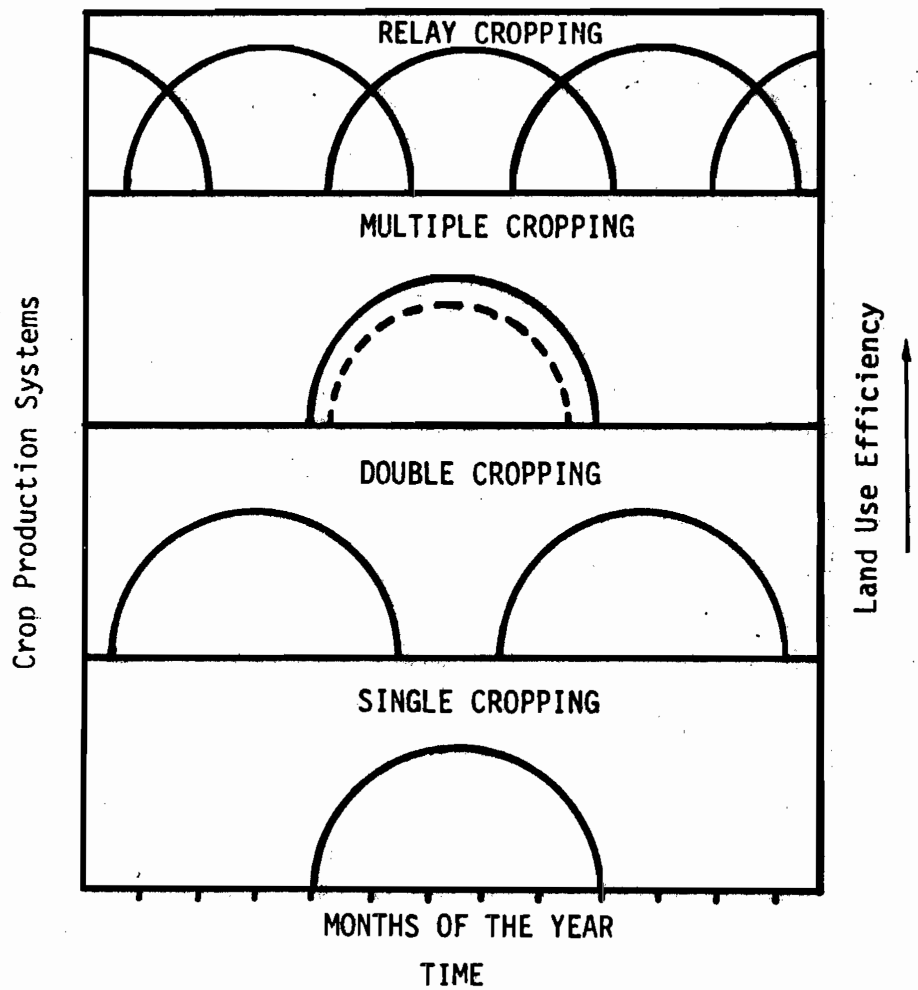

Figure 3. Principle crop production systems expressed as a function of time.

Table 5. Principle crops and production systems in Colombia.

COOL CLIMATIC ZONE

Cool Climatic Zone	Peas	Barley	Corn	Potato	Wheat	Garden Vegetables	Beans
Peas		Double crop	Double intercropping	Double intercropping	Double crop	Double crop	--
Barley			Double crop	Double crop	Double crop	Double crop	--
Corn				Double crop	Double crop	Double crop	Double intercrop
Potato					Double crop	Double crop Relay crop	Relay crop
Wheat						Double crop	--
Garden Vegetables						Intercrop	Relay crop

MODERATE CLIMATIC ZONE

Cool Climatic Zone	Corn	Cassava	Vegetables	Coffee	Cacao	Plantain	Beans
Corn		Intercrop	Double crop Relay crop	----	--	Intercrop	Intercrop Relay crop
Cassava			Intercrop	Intercrop	Intercrop	Intercrop	Double intercrop
Vegetables			Intercrop Relay crop	--	--	--	--
Coffee				--	--	Intercrop	--
Cacao					--	Intercrop	--
Plantain							--
Beans							--

WARM CLIMATIC ZONE

Cool Climatic Zone	Corn	Vegetables	Cassava	Rice	Sorghum	Soybean	Cacao	Sugar Cane	Tobacco
Corn		Intercrop	Double intercrop	Double crop	Double crop	Double crop	Intercrop	Intercrop	Double crop
Cassava		Intercrop	--	Double crop	Double crop	Double crop	--	Intercrop	Double crop
Rice		--	--	--	Double crop	Double crop	--	--	----
Sorghum		--	--	--	--	Double crop	--	Double crop	Double crop
Soybean		--	--	--	--	--	Intercrop	Double crop	--
Cacao		--	--	--	--	--	--	--	--

(fava bean), potato, cassava, squash, and some perennials (e.g. cacao, coffee and plantain) are often found in mixed intercropping associations, especially during the early years of crop establishment (Alarcon et al. 1980).

Agronomically, double cropping, intercropping and relay cropping favorably affect various aspects of production: (1) they more evenly deplete the soil, (2) they stabilize pest and pathogenic populations, and (3) they make better use of water, soil and technological resources. Economically, intercropping and relay cropping are more efficient and by diversifying the market risk over more than one crop, growers actually decrease the economic risk involved. In fact, it is precisely the intercropping and relay cropping systems that are heavily used on small farm systems (Alarcon et al. 1980).

Generally throughout Latin America, crops can be separated by the climatic zones in which they are grown: cotton, rice, plantain, sugar cane, cacao, coconut, citrus, mango, pineapple, peanut, sorghum, soybean, and cassava are found in the warm climates; beans, coffee, some vegetables and fruit trees, and plantain are found in the moderate climates; wheat, barley, potato, and vegetables are grown in the cool climates. Perennial crops are found principally in the warm-humid climatic zones while the annual crops are grown predominantly in the climatic zones with an adequate distribution of rainfall and with a dry period during which the crop can mature and be harvested. Corn and beans are the only crops that are grown commercially in diverse climatic conditions. In fact, corn was a major crop in all zones of all countries visited. Sorghum and some grain legumes (e.g. cowpeas) have been adapted to climatic zones low in precipitation. On the flatter lands in the valleys, highlands, and coastal plains, mechanized farms of large size dominate, and crops such as cotton and sugar cane are grown. On steeper slopes, perennial crops such as coffee predominate, but some corn and beans are also grown under weed-free conditions. This often leads to the erosion of valuable top soil. In the highlands that traditionally grow wheat, barley, corn, and potatoes, there is a displacement of these by vegetable crops near larger communities where a market exists.

The coastal area of Peru is somewhat unique for, though it is at sea level, it is cool and everything is raised under irrigation (Table 6). Potato forms a major crop under that system, as do a variety of fruit trees, cotton, sugar cane, and rice. Many of these crops are grown in cooperatives, especially cotton, sugar cane, citrus, and rice, and as such are not really grown at the small farm level.

Many of the crops in all of the cropping systems discussed serve a double purpose, subsistance and cash. This is especially true of rice, vegetables, fruits,

Table 6. Small farm cropping systems in Latin America by climatic zones

Central America and Parts of Colombia

Humid Low Lands

- Corn
- *Plantain
- Cassava
- *Cacao
- *Grain legumes

Moderate Mid Lands

- Corn
- Beans
- *Coffee

Cool Highlands

- Potatoes
- Corn
- *Small grains
- Beans
- *Garden vegetables

Peru and Parts of Colombia

Arid Cool Coastal Low Lands

- Corn
- *Potatoes
- Beans

Interandean Valleys

- *Corn
- *Potatoes
- Beans
- Small grains

Highland Humid Tropics

- Corn
- Cassava
- *Rice
- *Grain Legumes
- *Tobacco

Low Humid Tropics

- Cassava
- Rice

* = primarily a cash crop in the small farm cropping system.

and beans. The extent to which these variable-purpose crops are grown depends upon access to a market and the country's infrastructure. These aspects have been discussed above. The cropping system is a variable and dynamic unit, fluctuating in space and time. It is imperative that this be kept in mind as various production constraints, crop protection among them, are discussed, for the severity and intensity of many of the pest problems (weed, disease, nematode, insect, vertebrate) of one crop are intricately woven with and drastically affected by other crops in the system and by various control practices employed.

Land preparation is one of the factors that greatly affect the protection situation. A brief account of these for the areas visited is presented below.

Land Preparation

Guatemala. In the flatter lands in the highlands of Guatemala, land was prepared either by hand hoeing (most common) or by oxen and, in a few cases, disc plowing by tractor. On the steeper slopes in Guatemala, land preparation was mainly accomplished by hand hoeing. Most of the corn stalks were fed to livestock. Where corn stalks or wheat stubble were present, they were sometimes worked in, sometimes burned. Although erosion was not serious on many soils, it was on others.

Costa Rica. In Costa Rica, 80-90% of the small farm corn fields in the Atlantic zone have been planted for years without preplant tillage (M. Shenk personal communication). Paraquat has replaced hand cutting to reduce weeds prior to planting for the past few years in the Atlantic Zone of Costa Rica.

Colombia. There were conflicting statements made by different individuals and in an ICA publication relating to land preparation in Colombia. Apparently, land in the valleys is generally tilled before planting with tractors, oxen or on small plots by hand. This is especially true for potatoes and vegetables. Land is tilled on hillsides as well as in valleys for cassava. There is a belief that land must be tilled before planting cassava to produce a good crop. The staff at CIAT is going to study reduced tillage and tilling only the spots where it is planted. Erosion is a serious problem in the hills where much of the cassava is grown and reduced tillage would reduce this problem. On steep land, a primitive plow pulled by oxen and hand hoeing seemed to be common methods of land preparation.

The ICA multiple cropping staff indicated that fields are sometimes burned but not tilled prior to planting mixed stands of corn and beans. They stated that this system prevented insect problems whereas working the soil resulted in insect damage. The Agricultural Engineering staff at ICA stated that 132 man hours are required per hectare to prepare land by traditional methods. With new equipment they have reduced this to 38 man hours. They are conducting experiments on corn, wheat and barley on traditional compared with minimum and no tillage. They pointed out that due to rainfall patterns only a short period of time exists to prepare the land. Minimum tillage would reduce the time required for land preparation during this critical period. They indicated that weed control is a key element in tillage research. Unfortunately, they have no weed scientist working with either the multiple cropping or agricultural engineering staffs at ICA/Tibaitata and CIAT currently has no weed scientist.

Peru. On the coast of Peru all crops are completely dependent on irrigation. Land is tilled and ridged or diked for surface irrigation before planting. After planting, cotton, corn, beans, potatoes, sorghum, and vegetables are generally cultivated between the rows as well as hand hoed within the rows. However, sugar cane is treated with herbicides and maintained under no-till. Rice, most of which is transplanted, land is generally treated with herbicides.

In the mountains, it was stated that most land is tilled before planting. On the steep hills it is worked by hand while on the gentle slopes and flat land it is commonly worked by oxen and a primitive plow. Tractors are rare in the mountains. They say they need to till the soil before planting because it is hard and, where irrigated, they must make furrows for water. On the steep slopes where erosion is serious and irrigation is not as commonly used, research is needed to determine the effect of minimum tillage and no-till systems on yields and erosion.

In the high jungle near Tarapoto land is still farmed by the "slash and burn" system. The first and second years they usually plant corn or rice with a stick and with no tillage. The third year the land commonly goes into pasture or may be allowed to revert back to forest. On the more level areas near roads, more of the land is in permanent agriculture and often tilled with a tractor.

Production Constraints in Latin America

In Colombia, a rating system has been developed that categorizes production constraints according to 1) slight (not a spatial or temporal constraint on a regional or national level, but only with regard to local environments or on a sporatic basis); 2) moderate (some factor or series of factors causing a production constraint at a regional or national level, though these factors are not greatly limiting in production); 3) major (a single or several factors together are responsible for crop losses on a national level; these factors are present most years); 4) key (a single or a set of factors that is so constraining to crop productivity on a national level that an all-out effort through careful planning and coordination of institutional programs at regional and national levels is needed) (Alarcon et al. 1980).

These constraint ratings have been used for various crops in the various ecological zones of Colombia and have been divided into agronomical constraints, plant breeding constraints, soil and water constraints, weed constraints, disease constraints and entomological constraints. Means of these various constraints for all six main ecological crop zones of Colombia have been tabulated (Table 7). These data suggest, at least according to ICA (Instituto Colombiano de Agropecuaria) personnel, that, across the many crops, the non-protection constraints are slightly more important than are the protection constraints (Table 7). Among the protection constraints, clearly those that fall into the area of plant pathology (fungus, bacteria, virus, mycoplasm, nematodes) are most limiting to production. The weeds and insects are about equal as limiting factors to crop production (Table 7). The reason entomological constraints are not more limiting is that insecticides, in the short term, prove a reliable constraint deterrent. In the long run this may not be the case. Several of the factors that place plant pathology high on the constraint index are related to virus and mycoplasma-like organisms that cause crop losses and are transmitted by insect vectors. For instance, corn has been found to be infected by more than 7 different viruses and mycoplasm-like agents in Peru alone. Many of these cause severe crop losses and all are transmitted by insects (Nault 1980).

A successful cropping systems research program must depend heavily upon: (a) a careful analysis of the land and climatic base: (b) an understanding of the extent and importance of major land systems or complexes; (c) an understanding of present land use patterns on given land systems; (d) an understanding of environment technology interaction; (e) a basis for setting of priorities for cropping systems research work, partly in relation to the farm systems to be studied and resource use and management issues; and (f) a basis for transfer of technology from research to the farmer, especially where the natural resource base is a major determinant in management systems (CGIAR 1978). In fact, this chain of events from constraint identification to implementation of research results reducing the constraint at the farmer level presents another set of constraints on top of the ones already discussed. We have found that this chain of events is almost always broken, usually in the delivery of improved technology to the farmer, in all Latin American countries visited. The delivery/extension aspect will be covered more thoroughly under the sections on countries and institutions.

Table 7. Indices of agronomic constraint factors for the more important crops of Colombia (means of constraints for various ecological zones) (Alarcon et al. 1980).

	Crop Agronomic Constraints			Crop Protection Constraints		
Crops	Soils & Water	Agronomic	Plant Breeding	Entomological	Plant Pathological	Weeds
Barley	2.0	2.0	3.0	1.0	3.0	2.0
Bean	2.3	2.6	3.3	2.6	3.6	2.3
Cacao	2.6	3.4	3.4	1.0	3.6	2.2
Cassava	3.5	3.3	3.6	2.6	4.0	3.6
Citrus	3.3	2.6	2.6	2.6	3.6	1.6
Coconut	4.0	4.0	4.0	4.0	4.0	4.0
Corn	3.2	2.6	2.2	2.2	2.2	2.4
Cotton	3.3	2.6	2.6	3.3	1.3	2.0
Garden Vegetables	2.5	3.5	4.0	2.0	3.0	2.5
Mango	3.3	3.0	2.6	1.0	2.6	2.0
Other fruit trees	3.5	3.8	4.0	2.8	3.0	1.8
Peanut	3.3	3.3	3.3	1.6	3.6	2.3
Pineapple	2.6	3.3	2.6	1.0	1.6	2.6
Plantain	3.0	3.8	2.6	3.6	4.0	3.0
Potato	4.0	3.0	2.0	3.0	4.0	2.0
Rice	3.6	2.3	3.0	1.6	3.3	2.3
Sorghum	3.3	2.3	2.6	1.6	1.6	2.3
Soybean	3.0	1.0	2.0	1.0	2.0	2.0
Sugar Cane	2.5	3.1	2.6	2.8	1.8	1.3
Tobacco	3.2	2.5	2.0	1.0	3.0	1.5
Wheat	2.0	1.0	2.0	1.0	3.0	1.0
Means	3.0	2.8	2.9	2.1	2.9	2.2
Overall Means		2.9			2.4	

1 = slight constraint; 2 = moderate constraint; 3 = major constraint; 4 = key constraint (see text).

A significant aspect of constraints and constraint areas is that all are critical and it is necessary to simultaneously reduce them, not only among disciplines (entomology, plant pathology, weed science) but also along the chain of events necessary to accomplish their reduction as constraints.

Crop Protection Situation

For the purposes of this report, we will focus on the complex of insects, fungi, bacteria, nematodes, viruses, vertebrates and weeds that, through direct feeding or competition, tend to lessen the potential output of crops that form the major cropping systems for small farmers. This complex of organisms, then, can be called pests in the broad sense, and it is these to which we will specifically address ourselves. When one attempts to understand these pests in the context of an ecological setting (agro-ecosystem), it is fundamentally important that the following information be gathered: (1) the identification of the organisms causing damage, 2) biologies and life cycle data on these organisms, 3) life table data on the species, 4) host plants of the organisms, 5) their behavioral attributes, 6) abiotic and biotic factors affecting population build-up and declines, and 7) natural enemies (biological control agents). The ecological understanding of the generalized cropping systems discussed above is paramount in determining species of pests and their phenologies and population dynamics in each climatic zone.

Colombia has also developed a system to rate the relative degree of pest and other production problems that are currently managed. The rating system includes good (= 1) (all factors leading to appropriate, efficient, and economic control are known, including the ability to keep pest populations below economic injury levels); adequate (= 2) (satisfactory knowledge about control methods exist with rational application procedures); deficient (= 3) (poorly known; biology and habits of causal agents unknown; lacking inventory of beneficial biota; control methods not appropriate, either too costly or not based on economical criteria); and none (= 4) (problems unknown; no biological studies or knowledge exists; control methods not evaluated, untested; ecological effects also unknown). Six zones of Colombia were scored with respect to crop, area and discipline (I = insect pests, D = disease, W = weeds) (Table 8) (Alarcon et al. 1980).

Table 8 indicates that only in a very few cases is the state of knowledge about a group of pests good, and most of the cases where the state of knowledge is either good or adequate occur in the interandean valleys where farms are larger

Table 8. . State of knowledge of management techniques of crop protection problems for the crops by ecological zones in Colombia (Alarcon et al. 1980).

ECOLOGICAL ZONES OF COLOMBIA

rops	Andian			Valleys			Pacific			Carrabean			Orinoquian			Amazonian		
	I	D	W	I	D	W	I	D	W	I	D	W	I	D	W	I	D	W
arley	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bean	3	2	1	3	2	1	-	-	-	4	3	2	-	-	-	-	-	-
Cacao	3	3	3	-	-	-	3	4	3	3	3	3	4	3	4	4	4	4
Cassava	3	3	2	3	3	2	-	-	-	3	3	3	3	3	3	4	3	3
itrus	3	3	3	3	3	2	-	-	-	3	3	3	-	-	-	-	-	-
oconut	-	-	-	-	-	-	3	3	3	3	4	3	-	-	-	-	-	-
orn	3	3	1	1	3	1	-	-	-	3	3	3	4	4	4	4	4	4
otton	-	-	-	1	2	1	-	-	-	3	3	3	-	-	-	-	-	-
arden Vegetables	3	2	2	3	2	2	-	-	-	4	4	4	4	4	4	4	4	4
ango	3	4	3	3	4	3	-	-	-	4	4	3	-	-	-	-	-	-
her Fruit Trees	4	4	4	4	4	4	-	-	-	4	4	4	-	-	-	-	-	-
eanut	4	3	2	3	3	2	-	-	-	-	-	-	4	3	4	-	-	-
ineapple	3	4	3	3	4	3	-	-	-	4	4	4	-	-	-	-	-	-
lantain	3	3	2	4	2	1	4	4	3	4	3	2	4	3	2	4	3	3
otato	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ice	-	-	-	1	3	1	4	4	4	3	3	2	3	3	3	4	4	4
rghum	-	-	-	2	3	1	-	-	-	3	3	3	3	3	2	-	-	-
ybean	-	-	-	3	3	1	-	-	-	-	-	-	-	-	-	-	-	-
ar Cane	4	4	3	2	3	2	-	-	-	4	4	3	-	-	-	-	-	-
bacco	3	2	2	3	2	2	-	-	-	3	2	2	4	3	2	-	-	-
heat	4	4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Means	3.2	3.0	2.2	2.6	2.9	1.8	3.5	3.8	3.3	3.4	3.3	2.9	3.7	3.2	3.1	4.0	3.7	3.7

= insect pests; D = diseases; W = weeds; 1 = good (all factors leading to appropriate, ficient, and economic control are known, including the ability to maintain pest populations low economic injury levels); 2 = adequate (satisfactory knowledge about control methods exist ith rational application procedures); 3 = deficient (poorly known; biology and habits of usal agents unknown; lacking inventory of beneficial biota; control methods not appropriate, ither too costly or not based on economic criteria); 4 = none (problems unknown; no biogical knowledge exists; control methods untested, ecological effects unknown); - = crop es not grow in that zone.

and production is more commercialized. The table also indicates that very little is known about the protection problems in the Amazonian, Pacific, Caribbean or Orinoquian areas, and that slightly more is known in the Andean area. The table also suggests that, in general the state of knowledge of weed control is better than that of disease control, and that insect control is the least understood, except under mechanized farming.

The incidence of pests has no real correlation with the degree to which they can be controlled. Table 9 indicates that where the incidence is great (= severe), the control can be good to deficient. In general, the incidence is lower and control measures better for weeds than for insects, and better for insects than for diseases.

Weeds. Some of the important weeds seen in the areas visited are listed in Appendix B. Since only small parts of each country were visited, the weeds listed represent only a few of those present in each country. The species present in any one area are dependent on temperature, moisture, cropping system and whether or not the weeds have been introduced into the area. Highland weeds, for the most part, differ from those of hot valleys and jungle areas. Many of the serious weeds in irrigated rice fields are not important in upland crops in the same area. *Rottboellia exaltata* almost always becomes a serious pest in warm, moist areas once it has been introduced. It is serious and widespread in the Cauca Valley of Colombia. It is now the most serious weed in Panama yet it has just appeared in the Atlantic Zone of Costa Rica (M. Shenk, personal communication). Based on worldwide experience, it should become important in the latter area soon. In Tarapoto, Peru, *Rottboellia* has been known only a few years, yet it is already a very serious pest.

Weeds differ in their severity from area to area and from one part of the season to another. They were especially troublesome in the hot, moist areas, including irrigated rice and sugar cane. Many of the popular pasture grasses such as *Panicum maximum*, *Pennisetum clandestinum*, *Cynodon dactylon* and other *Cynodon* species are serious weeds when they invade cropland. Therefore, caution should be observed when these are considered for introduction into new areas. Some weeds are widespread. These include *Cyperus rotundus*, several annual and perennial grasses, *Bidens pilosa*, *Amaranthus* spp. and *Ipomea* spp.

The most common method of weed control seen was hand hoeing, pulling or cutting. As long as plenty of labor is available this was observed to be reasonably effective. The major problems were lack of effective control of perennial grasses and sedges and failure to remove weeds before the crop was damaged by competition.

Table 9. Actual incidence (I) and control (C) of pest groups (insects, diseases, weeds) of important crops in Colombia (after Alarcon et al. 1980).

	Insects	Diseases	Weeds
Crop	I - C	I - C	I - C
Barley	2 - 1	3 - 2	1 - 1
Bean	3 - 1	3 - 4	1 - 2
Cacao	1 - 1	3 - 4	1 - 1
Cassava	3 - 3	3 - 4	3 - 2
Citrus	3 - 4	2 - 3	2 - 3
Coconut	3 - 4	3 - 4	2 - 3
Coffee	1 - 1	2 - 3	1 - 2
Corn	3 - 3	2 - 3	1 - 2
Cotton	3 - 3	1 - 3	3 - 2
Garden vegetables	2 - 4	3 - 3	1 - 3
Mango	1 - 4	1 - 4	1 - 4
Peanut	1 - 4	3 - 4	1 - 3
Pineapple	3 - 4	1 - 4	1 - 3
Plantain	3 - 3	3 - 3	1 - 2
Potato	3 - 2	3 - 3	1 - 2
Rice	2 - 1	3 - 2	3 - 2
Sorghum	3 - 3	2 - 3	3 - 1
Soybean	1 - 1	2 - 3	1 - 2
Sugar cane	3 - 3	2 - 4	2 - 2
Tobacco	1 - 2	3 - 3	1 - 2
Wheat	1 - 1	3 - 3	1 - 1
Means	2.2 - 2.5	2.4 - 3.3	1.5 - 2.1

I = incidence:

1 = light (damage occurs only under local conditions; infrequent control measures needed).

2 = occasional (damage cyclic and requires control measures).

3 = severe (causes a problem if not controlled periodically).

C = control:

1 = good (control measures exist and applied excellently at local, regional, national levels).

2 = adequate (control measures exist and are applied effectively in the majority of cases).

3 = moderate (control measures exist but they are not applied effectively).

4 = deficient (no control measures exist).

Where Rottboellia was present it was almost impossible to keep up with it by hand weeding alone. Some of the non-herbicide methods of control used are given below. Herbicides are discussed later.

Pre-plant tillage by tractor, oxen or hand killed annual weeds and delayed competition from perennials. It was mentioned that on the coast of Peru, johnson grass is attacked by using a moldboard plow followed by harrowing to drag off the rhizomes. Then sweet potatoes are planted to give a quick canopy to inhibit johnson grass growth.

Mechanical cultivation between the rows is far less common than in the U. S. but is used by larger farmers on the more level land.

Throughout the tropics it is common to transplant many vegetables that are often direct-seeded in temperate regions. This is done to give the crops a start before weeds overtake them. Tomatoes, peppers, onions, cabbage, cauliflower and most lettuce was transplanted in the areas visited. In Peru nearly all the coast rice was transplanted.

Flooding of rice is another method used to control terrestrial weeds. However, in both Colombia and Peru, it was stated that weeds were the most serious pest problem of rice.

Rotation of crops is another weed control method widely practiced. In extreme instances this involved "rotation" with several years of pasture or forest before again planting cultivated crops for 2 or 3 years.

In Guatemala an unique planting method used for corn was observed to be highly effective in control of weeds. Corn was planted very deep into moist soil during the latter part of the dry season. By the time the rains start the corn is a foot or more high and few weeds are present due to the surface remaining dry.

Mulches are highly effective in control of seedling weeds. In Costa Rica where the vegetation was killed by a pre-plant herbicide treatment and corn planted through the mulch thus established, few weeds emerged. In the CIAT bean program, research on mulches of sugar cane waste and rice hulls is being conducted.

Close spacing of crop plants and intercropping can be helpful in controlling weeds by giving a quick canopy. However, as observed in the countries visited the crop spacing was too wide to be of much value in this regard.

It was mentioned that placement of fertilizer in the soil near the crop seeds can stimulate crop growth without stimulating weeds that are not close to the fertilizer. This is an effective method of favoring crop growth over weed growth.

Large increases in corn yields have been demonstrated with no-till versus tillage before planting (M. Shenk and J. Saunders personal communication.) Much of this response appears to be due to greatly decreased soil insect problems that result in much better corn stands, better growth and less lodging under no-till conditions. We saw excellent results in the experiments in the Atlantic Zones of Costa Rica. Unfortunately, hundreds of farmers paid (at a subsidized price and tied to credit) to have their land tilled before planting this year. In addition to severe insect problems, there was much more trouble in tilled land with a serious grass weed Rottboellia exaltata.

The cost of tillage plus hand weeding was found to be considerably higher than various no-till systems studied (M. Shenk, personal communication). Thus, the advantages of no-till include higher yields (due to less insect damage) and lower cost.

Other potential benefits of minimum tillage techniques are better moisture for crops during dry periods, reduced soil erosion and compaction, reduced energy inputs, less restrictions from wet weather for entering and preparing fields, quick "turn around time" in double and triple cropping systems, and increased area that a small farmer can crop without needing non-family labor. Pre-plant tillage practices and minimum-tillage should be investigated closely since at the end of the dry season few weeds were present in fields following a minimum tillage practice. Leaving trash on the surface, instead of burning it or working it in, might also reduce erosion, conserve moisture and reduce energy inputs whether fossil fuel, animal power or human labor.

Diseases. Diseases, especially those caused by fungi, bacteria, and viruses, can, if not controlled, result in severe economic losses to a number of economically important crops. The agents of diseases found to cause some economic damage are listed in Appendix C. A discussion of the most important diseases, by crop, follows:

BEANS

Bean Rust, (Uromyces phaseoli); Angular leaf spot, (Isariopsis griseola); Anthracnose, (Colletotrichum lindemuthianum); Common Blight, (Xanthomonas phaseoli); Web Blight, (Rhizoctonia microslerotia); and many viruses are among the most important diseases of beans in Latin America (Echandi and Belas 197; CATIE, UC/AID, and OIRSA, 1979; Alarcon et al. 1980). Continuous bean culture, failure to crop rotate and minimal tillage are among the practices used that favor increased incidence of many of these diseases.

Constraints under which farmers are currently operating are lack of information on these diseases, suitable land space to rotate crops, and steep slopes where conventional tillage practices would lead to more serious erosion problems. Selection of resistant varieties, disease free seed and the use of pesticides are practices that could be employed but are often unknown or not available to the farmer. Fungicides are used in some instances for bean rust, however, the most effective fungicides are often not used or not available.

CASSAVA

The more important cassava diseases in Central America are powdery mildew (*Oidium manihotis*), scab (*Sphaceloma* sp.), rust (*Uromyces manihotis*), Cercospora leaf spots (*Cercospora henningsii* and *Cercospora caribaea*), and die back (*Colletotrichum* sp.) (Moreno 1979).

Many farmers intercrop cassava with beans. Moreno (1979) showed a decrease in cassava powdery mildew and angular leaf spot of bean when cassava and bean were intercropped compared to growing monocultures of each. Orientation of cassava field and intercropping with corn or plantain has decreased the amount of cassava scab since strong winds produce wounds that favor *Sphaceloma* entry. Intensive cassava production in Colombia has resulted in more serious disease problems than is now occuring in the limited cassava production in Central America.

Among the more important diseases of cassava in Colombia and Peru, in addition to those listed in Central America, are: Cassava Bacterial Blight (*Xanthomonas manihotis*), virus and mycoplasmic diseases (Cassava common mosaic disease, Cassava leaf vein mosaic disease, Cassava latent virus, Cassava witches - broom, and Frog skin disease), and root rots (*Phytophthora* spp.) (Berkelbaum *et al*. 1977; Alarcon *et al*. 1980).

Quite likely more cassava production would lead to more disease; however, based on the studies of Moreno and the desire of small farmers to intercrop, an increase in cassava production is encouraged. Cassava can do quite well on marginal soils and has high nutritive value (see Staple Crops Section).

A constraint facing farmers producing cassava is the 10-16 month planting to harvest period and the increased potential of soil erosion in cassava plantings. This crop is an excellent subsistence crop.

COFFEE

Coffee rust (*Hemileia vastatrix*) disease is of primary concern to all Latin American countries. Coffee rust was seen in Guatemala, Colombia and Peru, but not in Costa Rica. "More emphasis should be directed toward breeding material and screening using tissue culture technique" Trujillo, ROCAP Guatemala. Brown spot (*Cercospora coffeicola*) is also a major disease and the most important at the present time in Costa Rica. Heavy fertilization and removal of shade crops are farmer practices that increase brown spot severity.

Coffee is a dependable cash crop. Intercropping with plantain, corn or some other crop to provide adequate shade is required. Retention of such shade is necessary to prevent serious brown spot disease. Plantain is often used but has a severe nematode problem that causes lodging in some areas.

CORN

Virus diseases, commonly referred to as Achaparramiento (dwarfing) and *Diplodia macrospora* (leaf and ear rot) disease, specially in Costa Rica, can be severe and limit corn production. In Colombia and Peru, corn viruses are the number one disease problem. Other diseases that may limit corn yields are *Helminthosporium* leaf blights, and various ear rots.

The relative importance of corn diseases in wet lowlands, dry lowlands and highland is shown in Table 10 (Brewbaker 1979). Other important corn diseases in specific regions are listed in Appendix C. Continuous corn culture in many areas has allowed high population build-up of insect virus vectors and fungal inoculum.

Intercropping corn with other crops has led to an increase of diseases that are favored by high moisture conditions and a decrease in diseases caused by insect vectored viruses and wind disseminated inoculum (Moreno, personal communication). Crop sequence and seed-bed preparation frequently have been identified by small farmers as the most important management practices influencing disease development in corn.

In Costa Rica, *Diplodia* leaf spot disease increased in corn monoculture and corn relay cropping with beans when compared to a corn and bean rotation. The same disease was more severe under no-tillage and minimum tillage land preparations than conventional tillage. The reverse was true of the ear rot phase.

Considerable emphasis in corn virus research is underway in Colombia (Martinez, personal communication) and Peru, where two additional mycoplasmas and five additional viruses were identified for the first time (Nault *et al*. 1979; Nault 1980). Previously only two virus diseases of corn were reported from Peru.

Constraints include recognition of pathogenic diseases by farmers (many think of virus infections as nutrient deficiencies) and information on how to deal with their problems. Most farmers in Central America are not aware of corn breeding programs at CIMMYT.

PLANTAIN

Moko (*Pseudomonas solanacearum*), and Panama Disease (*Fusarium oxysporum* f.sp. *cubense*) are two consistently important plantain diseases in all of Latin America.

Table 10. Potential importance on a 0-3 scale[a] of tropical corn diseases in the wet lowlands (Peten), dry lowlands (Chichen Itza), and the highlands (Kaminaljuyu) of Mexico (from Brewbaker 1979).

Disease	Wet lowland	Dry lowland	Highland
Foliar Diseases			
1. No. leaf blight (*Helminthosporium turcicum*)	2	1	3
2. So. leaf blight (*H. maydis*)	3	2	0
3. *Helminthosporium carbonum*	1	1	1
4. Common rust (*Puccinia sorghi*)	0	0	2
5. Southern rust (*P. polysora*)	2	1	1
6. Tropical rust (*Physopella zeae*)	1	0	0
7. Tarspot (*Phyllachora maydis*)	1	0	1
8. *Curvularia* leaf spots (*Curvularia* spp.)	2	1	1
9. Brown spot (*Physoderma maydis*)	1	1	1
10. Zonate leaf spot (*Gloeocercospora sorghi*)	1	0	0
11. Bacterial leaf stripe (*Pseudomonas rubrilineans*)	1	0	0
12. Banded leaf & sheath blight (*Corticum sasakii*)	1	0	0
13. Eyespot (*Kabatiella zeae*)	0	0	1
14.[b] Others (*Phyllosticta* and *Cercospora* leafspots, *Colletotrichum anthracnose*, *Septoria blotch*)			
Smuts & Ergot			
1. Common smut (*Ustilago maydis*)	0	0	1
2. Head smut (*Sphacelotheca reiliana*)	0	1	2
3. False smut (*Ustilaginoidea virens*)	0	1	0
4. Ergot (*Claviceps gigantea*)	0	0	1
Downy Mildews			
1. Sorghum (*Sclerospora sorghi*)	2	2	0
2. Crazy top (*Sclerophthora macrospora*)	1	0	0
3.[b] Others (*Sclerospora maydis*, *philippinensis*, and other species)	3	3	0
Stalk Rots			
1. *Diplodia maydis*	1	1	2
2. *Fusarium roseum* (*Gibberella zeae*)	0	0	2
3. *Fusarium moniliforme* (*G. fujikoroi*)	2	1	1
4. Charcoal rot (*Macrophomia phaseoli*)	1	2	2
5. *Pythium* spp.	2	2	0
6. Bacterial (*Pseudomonas* spp., *Erwinia* sp.)	2	1	0
7. Late wilt & black bundle (*Cephalosporium* spp.)	2	2	0
8. Anthracnose (*Colletotrichum* sp.)	2	1	0
9.[b] Others (*Aschochyta*, *Botryodiplodia*, *Helminthosporium*, *Nigrospora*)			
Ear and Kernel Rots			
1. *Diplodia* spp.	1	0	2
2. Pink ear rot (*Gibberella zeae* = *F. roseum*)	0	0	2
3. *Fusarium moniliforme* (*G. fujikoroi*)	2	2	1
4. *Nigrospora* cob rot (*N. oryzeae*)	1	1	1
5. Grey ear rot (*Physalospora zeae*)	1	1	0
6. *Botryodiplodia*, *Rhizoctonia*, *Cephalosporium*	1	0	0
7. Stored grain rots (*Penicillium*, *Aspergillus*)	1	1	1
Viruses and Virus-like Diseases			
1. Maize mosaic virus (MMV)	3	1	0
2. Maize dwarf mosaic virus (MDMV)	2	2	1
3. Corn stunt spiroplasm (CSS)	2	2	1
4. Maize fine stripe virus (MFSV, or "rayado fino")	1	1	1
5.[b] Others (MRDV, MSV, MCDV)			

[a] Renfro & Ullstrup (1976) scale: 0 = absent or rare; 1 = minor importance; 2 = moderate importance; 3 = major importance

[b] Diseases that are temperate or unknown in this region.

In 1979, Sigatoka (Cercospora musae) disease was serious in Costa Rica. Moko and Panama Disease are caused by a soil inhabiting bacterium and fungus respectively, which makes control difficult, especially in the perennial coffee crop. Crop rotation to other land sites are not always possible. Most farmers do not appear to have many options open to them to control these diseases since those that do have adequate land space may run into problems rotating land sites due to the wide host range of these soil microorganisms. Availability of resistant varieties should be examined.

SORGHUM

Anthracnose,(Colletotrichum graminocola) and Cercospora leaf spot (Cercospora sorghi) are two of the most important diseases of sorghum in Central America. There are good sources of resistance to anthracnose that should be more fully utilized by the small farmer. Two potentially threatening diseases where adequate sources of resistance are lacking are Sorghum Downy Mildew (Polysora sorghi) and Zonate Cercospora Leaf Spot (Cercospora sp.). Sorghum diseases of importance in Colombia and Peru were reported to be similar to those listed for corn.

Many sorghum varieties are not well adapted to the tropics. Favorable soils and adequate fertility are restraints in some areas. Progress has been made in the outreach program as evidenced by Guatemalan farmers who come to ICTA (where a strong sorghum breeding program exists) for information. Other constraints are similar to those listed for corn.

VEGETABLES

Important vegetables for small farmers in the high plain area include tomatoes, peppers, cabbage, potatoes, squash and peas. Late blight (Phytophthora infestans), and early blight (Alternaria solani) and brown rot (Pseudomonas solanacearum) diseases can be very serious on tomato and potato crops. Fungal sprays for the two blights could be quite beneficial if correct fungicides were chosen and timely applications were made. In some areas, fungicides are used while in others they are not. TMV in tomato and PVX, PVY and leaf roll viruses in potatoes are also severe and often yield limiting factors. Several viruses are among the most important pepper and squash diseases. Additional information is needed on the various strains of the Cucumber Mosaic Virus and other viruses that exist. Most of the cabbage and peas viewed on field trips appeared to be quite healthy although certain highland areas have had severe root rot disease on peas. Proper crop rotations, time of planting, selection of disease free seed, control of insect vectors and application of fungicides only when needed appear to be the most promising methods for reducing the incidence of diseases in vegetable crops. In some cases, lack of pesticide availability and of good healthy seed limit the small farmers chances of high yielding vegetable crops in a climate that is marginally suited for their growth.

Nematodes. Nematodes can also be serious pests of crops, especially under tropical environments. Commercial crops such as cotton, pepper, tea, coffee can be attacked by the root knot nematode (Meloidogyne sp.). Citrus crops are very susceptible to attack by Tylenchulus semipenetrans.

The usual means of controlling nematodes is crop rotation. This is possible where the farmer has enough land. It is much more difficult under the small farm system.

Following are a few of the major small farm crops, their important nematode associates, and control measures:

BEANS

Root knot (Meloidogyne sp.) and root lesion (Pratylenchus sp.) are the two most important nematode diseases on beans in Central America. Continuous bean or other host cropping systems favors nematode build-up. The root knot nematode alone can attack more than 2,000 known species of plants (Hogue). The spiral nematode, Helicotylenchus sp., is also listed as a bean problem in Peru (Herrera, personal communication). Burning of crop refuse may reduce populations of some of the nematode species present.

Failure to recognize nematode symptoms and unawareness of the problem is a key constraint for many Latin American countries.

The INIA Nematology Department at La Molina reports receiving from 3,500-4,000 samples requesting nematode analysis annually. Lack of land for suitable crop rotation and information on recommended rotations for specific nematode problems are additional constraints for farmers in many Latin American countries.

CASSAVA

Nematode diseases of cassava are generally not yield limiting nor in some cases mentioned (Lozano and Booth 1976); however, Brekelbaum et al. (1977) listed the following potential plant parasitic nematodes: Meloidogyne spp., Pratylenchus brachyrus, Rotylenchulus sp., Helicotytenchus spp., Rotylenchus spp., and Criconemoides spp.

COFFEE

Root knot (Meloidogyne sp.) and lesion (Pratylenchus sp.) nematodes are those listed as most common on coffee. They are not considered in Central America to be the major coffee limiting production factor.

Nematode problems in perennial crops, such as coffee, are often more difficult to control than in annual crops. Perennial crops, once established, are more difficult to rotate to new land production sites than are annual crops.

CORN AND SORGHUM

"Nematodes are quite likely a problem on corn and sorghum but no one has taken responsibility...it is a problem that needs attention" (Dr. Al Plant, Sorghum Breeder, ICTA, personal communication, Guatemala). Root lesion (*Pratylenchus* sp.) and root knot (*Meloidogyne* sp.) are the nematode species considered to be the most damaging to these crops.

Constraints include unawareness by farmer and researcher and lack of adequate personnel and facilities. Colombia and Peru appear to have more trained nematologists than the Central American countries visited, however, they too have a definite shortage of trained personnel.

PLANTAIN

In given areas, the nematode, *Radopholus similis*, can be very destructive to plantain crops and cause excessive lodging. Losses from lodging not only cause a loss of plantain fruit but also cause a loss of a shade crop for other intercropped plantings, especially the cash crop, coffee. Farmers are not treating soils with nematicides, except in Peru, where a very small percentage are estimated to use chemical control.

Where nematode problems are severe, nematicide applications may pay dividends especially if plantain is intercropped with coffee. However, lack of nematicide availability and, if obtained, the improper use of nematicides may be much more costly.

VEGETABLES

The root knot nematode (*Meloidogyne* sp.) can be very destructive to solanaceous crops and cucurbits. Lack of additional land space creates difficulties for small farmers to rotate out of infested areas. While fumigation with nematicides or soil sterilants may be economically feasible on high value cash crops, only a very few farmers are aware of their availability and utilize these means. Availability and cost of fumigants are major constraints.

In Peru, (Herrera, personal communication), root knot (*Meloidogyne* sp.,) and spiral (*Helicotylenchus* sp.) nematodes are the most important small farm vegetable crop nematode problems. Potatoes frequently are attacked by cyst nematode (*Heterodera* sp.).

Insects. Insects form one of the most important groups of crop pests in Latin America. There are four methods by which they do damage:

1. Indirectly, by feeding on parts of the plant not meant for consumption;

2. Indirectly, by transmitting viruses and other plant pathogenic agents;
3. Directly, by feeding on parts of the plant meant for consumption before the crop is harvested; and
4. Directly, by feeding in the stored product after harvest.

This site team is not focusing on the latter method although it clearly recognizes the importance of research and technology delivery concerning reduction of post-harvest losses.

A complete listing of insect pests by crop for Central America can be found in Appendix D.

As can be seen from Table 11 (compilation from Joseph Saunders, Fausto Cisneros, Juan Herrera, and Jorge Saramiento unpublished), many of the more important insect pests are found on many crops. While several crops may have insect species in common, it does not necessarily follow that the insect species increase with similar efficiency on different crops. In fact, the key pest species (those with an astrix*) are infrequently the same for different crops. However, it does suggest that cropping systems research must take into consideration rotations and intercropping combinations that minimize population build-up, and in fact break life cycles of important and key pests.

Control methods vary considerably with location, value of crop, and resources available to farmers of small holdings. In many areas insecticides are unavailable or too highly priced. For vegetable production, though chemical insecticides are widely used, they are often mis-used from the view point of safety, type, dosage, and timing. This points to the need for an integrated pest management approach in these areas. According to Dr. Trujillo (personal communication), in general, pesticide usage by small farmers is greatest near areas where large farmers are concentrated (eg. coastal plain where cotton is grown in Guatemala), and less common away from those zones.

Vertebrates. Most vertebrate pests in Latin America are pests of post-harvest products, especially rats and mice in stored grain. Of the few vertebrate pests observed under pre-harvest situations, birds are perhaps the most important, and these occur sporadically and prefer sorghum and occasionally rice. A line strung on poles with bells was effectively used in the Guatemalan highlands to reduce the pest status of grain-feeding birds.

Another problem we observed in the Guatemalan highlands was rodents, especially gophers, that feed on roots of vegetable crops such as cabbage.

Table 11. Common insect pests of important small farm crops in Latin America.

	PERENNIALS							ANNUALS											
	Cacao	Citrus	Coffee	Mango	Pineapple	Plantain	Sugar cane	Beans/legumes	Cassava	Corn	Crucifer	Cucurbit	Pepper	Potato	Rice	Sorghum	Tobacco	Tomato	Wheat/barley
LEPIDOPTERA																			
Agrotis ipsilon			x					*	x		x		x	x	x	x	x	x	x
Alabama argillecea								x	x										
Anticarsia gemmatalis								*											
Ascia monuste											*								
Chilo spp.										x					x	x			
Crambus spp.										x					x		x		
Diaphania spp.								x				*							
Diatraea lineolata										x						x			
Diatraea saccharalis															*	x			*
Elasmopalpus lignosellus								x		x			x		*	x		x	*
Epinotia aporema								x											
Erynnyis ello									*										
Estigmene acrea								*				x				x			
Etiella zinckenella								x											
Feltia subterranea		x	x				x	*	x	x	x	x	x	x	*		x	x	x
Hedylepta indicata								x											x
Heliothis virescens								x					x				*	x	x
Heliothis zea								x		*	x		x		x		x	x	*
Laspereyesia spp.								x								x			
Leptophobia eleusis											*								
Mocis latipes							x			x					*	x	x	x	
Pieris spp.											*								
Plutella maculipennis											*								
Pococera atramentalis										*									*
Prodoparce spp.								x	x				x	x			x	x	
Pseudoplusia includens								*		x			x					x	*
Rupela albinella															*				
Spodoptera eridania			x					x	x	x			x		x		x	x	*
Spodoptera exidua		x						x		x					x		x		

Table 11. Cont'd

	PERENNIALS							ANNUALS											
	Cacao	Citrus	Coffee	Mango	Pineapple	Plantain	Sugar cane	Beans/legumes	Cassava	Corn	Crucifer	Cucurbit	Pepper	Potato	Rice	Sorghum	Tobacco	Tomato	Wheat/barley
LEPIDOPTERA - cont'd																			
Spodoptera frugiperda			x				x	x	x	*	x		x	x	*	*	x	x	*
Symmestrichem cupsicum													x					x	
Trichoplusia ni								x	x		*	x				x	x		
COLEOPTERA																			
Acalymma spp.								x				x						x	
Agriotes spp.																		x	
Apion godmani								*											
Cerotoma spp.							x	*		x					x				
Chaetocnema ectypa (spp)							x			x					x	x		x	
Diabrotica balteata spp.						x	x	x		*		x	x	x	x	x		x	x
Diaprepes spp.		x					x		x					x	x				
Epicauta spp.							x			x		x	x	x				x	
Epilachna spp.		x						*				x							
Epitrix spp.		x						x			*		x	x	x		x	x	
Phyllophaga spp.		x	x		*	x	x	x	x	*	x		x	x	x	x	x	x	
Systena spp.							x	x			x		x	x			x	x	
HOMOPTERA																			
Aphis spp.		x					x	x				x	x			x	x	x	
Bemisia tabaci								x	x			x	x				x	x	
Ceroplastes spp.		x		x															
Coccus spp.		x	x	x															
Dalbulus maidis								x		x						x			
Draeculacephala spp.								x		x				x					
Dysmicoccus brevipes					*														
Empoasca spp.		x					x	*				x		x	x			x	
Hyadaphis erysimi												*							
Icerya spp.		x																	
Lepidosaphis bekii		*																	
Metcaphiela pertusa	x																		
Orthezia insignis (spp.)													x		x				x

	PERENNIALS							ANNUALS											
	Cacao	Citrus	Coffee	Mango	Pineapple	Plantain	Sugar cane	Beans/legumes	Cassava	Corn	Crucifer	Cucurbit	Pepper	Potato	Rice	Sorghum	Tobacco	Tomato	Wheat/barley
HOMOPTERA cont'd																			
Peregrinus maidis															x				
Protopulvinaria pyriformis				x															
Rhopalosiphum maidis							x	x		x	x			x	x				x
Saissetia spp.		x	x	x					x										
Selenaspidus articulatus		*																	
Sitophilis oryzae															*				x
Sogata orzicolo							x								*				x
Unaspis citri		x																	
HEMIPTERA																			
Acrosternum spp.								x			x								
Anasa spp.								x		x		x							
Blissus leucopterus							x	x		x					*	x			x
Cyrtomenus spp.															x				
Euschistus spp.		x						x				x		x	x			x	
Halticus bracteatus		x					x	x		x	x	x	x	x			x	x	
Leptoglossus spp.		x				x			x	x		x	x	x				x	
Lygus spp.								x						x	x				
Monalonium dissimulatum	*																		
Mormidea spp.								x				x			*				
Nezara virudula								x			x		x	x	x		x	x	
Nysius ericae								x		x				x		x			
Oebalus ypsilon-griseus															*				
Piezodorus guildinii								x							x				
Thyanta spp.								x		x					x	x			
Tibraca limbativentris															*				
THYSANOPTERA																			
Caleothrips fasciatus								x				x							
Caleothrips phaseoli								x		x		x							
Crynothrips stenopterus										*									
Frankliniella spp.						x		x	x	x					x			x	x
Thrips tabaci								x			x	x		x			x	x	

Table 11. Cont'd

	PERENNIALS							ANNUALS											
	Cacao	Citrus	Coffee	Mango	Pineapple	Plantain	Sugar cane	Beans/legumes	Cassava	Corn	Crucifer	Cucurbit	Pepper	Potato	Rice	Sorghum	Tobacco	Tomato	Wheat/barley
DIPTERA																			
Agromyza spp.								x		x	x	x		x				x	
Anastrepha spp.		x		x					x										
Ceratitis spp.		x	x	x	x							x	x					x	
Contarina spp.								x		x						*		x	
Euxesta spp.								x		x			x		x				x
Hylemya platura								x		x		x							
Hyperdiplosis sp.									*										
Liriomyza spp.								x				x	x	x				x	
Rhagoletis ochraspis													x					x	
HYMENOPTERA																			
Atta spp.		x	x	x		x		x	*	x			x	x			x		
ORTHOPTERA																			
Acheta spp.			x					x			x						x	x	
Gryllotalpa spp.															x				
Schistocerca spp.						x	x	x	x	x					x				
ACARINA																			
Mononychellus spp.									x										
Oligonychus spp.			x			x		x	x	x									
Tetranychus urticae (spp.)		x						x	*	x								x	

Locally, the farmers control this pest by injecting strychnine in the crop's roots. When a gopher eats an injected root, the entire population, so it is told, moves out of the field for a very long time.

Vertebrate pests are not, to our knowledge, a production constraint in any of the sites we visited. However, when devising a pest management program, they should not be neglected.

Pesticide Practice and Usage. Pesticides are invariably used more for commercial production by farmers with large holdings and others that produce exportable cash crops than by small subsistance farmers. This can be verified by viewing the various agricultural inputs registered by commodity and crop in Colombia (Table 12). Cotton and soybean, commercially grown, use many more insecticides than fungicides, and irrigated rice, on a commercial basis, uses large quantities of herbicides, insecticides, and fungicides. Corn, beans, peanut, sorghum, and potato, while grown as cash and subsistance crops, use far less chemical inputs, and wheat and barley use even less (Alarcon *et al*. 1980).

Pesticide sales in Colombia for both subsistance and commercial products totaled $125 million in 1979. The breakdown according to discipline is:

Insecticides	$ 65,000,000
Herbicides	42,000,000
Fungicides	12,000,000
Others	6,000,000
	$125,000,000

Insecticides. Organo-phosphates and carbamates made up the largest group of insecticides. Carbofuran (Furadan), Carbaryl (Sevin), Methyl Parathion, Azodrin, Baygon, and Lannate were some of the compounds used in considerable quantity within this group. Chlorinated hydrocarbons including Aldrin, Chlordane, DDT, Endrin, and Lindane were used in considerably less quantity than the above group. *Baccillus thuringensis* was reported to be used to some extent. It is not known just where the insecticides are applied but there is heavy use in cotton, bananas, rice, vegetables and several other cash crops.

In Peru, laws passed by the legislature regulate the use of pesticides applied to cotton in the coastal irrigated valleys. For the most part, lead arsenate is used, with treatments averaging three per season. This insecticide does not adversely affect beneficial arthropods. Carbamate and phosphate granules are sometimes used in rows for control of nematodes of cotton, corn, and potatoes.

Table 12. Principle inputs by annual crop, Colombia, 1978. (Alarcon *et al.* 1980). (dose=dosage/ha).

Crop	Herbicides product	dose	Insecticides product	dose	Fungicides product	dose	Fertilizers product	dose
barley	Esteron 47	2.3 lts.			Dithane M-45	2 kgs.	10-30-10	150 kgs.
	Ceresan Ester				Cebicin	1 kg.	13-26-4	150 kgs.
	3.34	2.3 lts.			Plantvax	1 kg.	25-15-0	120 kgs.
	2-4D Ester	2.3 lts.			Bayleton	1 kg.	15-15-15	150 kgs.
	2-4D Sal Amina	2.5 lts.			Azufre	2.5 kg.	Urea 46%	50 kgs.
					Daconil	2.5 kg.	Calfos	500 kgs.
bean	Lazo	3 lts.	Cottinex tri-ple	2 lts.	Benlate	250 grs.	Coljap (Desarrollo)	0.5 lbrs.
			Azodrin	1 lt.			Coljap (Florescencia)	1 lbr.
			Ekatin	0.5 lts.			Coljap (Producción)	1 lbr.
							Nitrofoska	2 lts.
corn	Gesaprim 80	1 - 1.5 kgs.	Cebicid	25 kgs.			Urea 46.5%	100 kgs.
	Atrazina	1.5 kgs.	Aldrin 2.5%	25 kgs.			Compuestos	300 kgs.
	Trissol	1.5 kgs.	Cutvel E.C.	3 lts.				
	Lazo	4 lts.	Azodrin	0.8 lts.				
			EPN-45	1 lt.				
			Sevin 80	2 kgs.				
			Dipterex SP-80	0.8-1 kgs.				
			Toxafeno DDT 40-20	1 -1.5 gal.				
			Sevimol	0.5 gal.				
			Basudin EC-600	0.8-1 lt.				
			Bux 360	2 gals.				
cotton	Treflan	3 - 4 lts.	Parathion	1,0 gal.			Urea 46%	200 - 150 kgs.
	Lazo	3 - 4 lts.	Malathion Tec.	1,0 gal.			Sulf.Amonio 21%	50
	Cotoran	3 - 4 lts.	Thuricide	300 grs.			15-15-15	100
	Lazo+Karmex	2,0Lts.+0.8kg.	Dipterex sp.80	800 grs.			14-14-14	100
	Treflan+karmex	2.0lts.+0.8 "	Metilparation	0.5-1,0 lts.			10-30-10	100
	Lazo+Cotoran	2,0lts.+2.0 "	Fundal 500	0.5 kgs.			16-20-20	50-100 kgs.
	Dual	3.5kgs.	Fundal 800	6.3 kgs.			Micro-Coljap	2-3 lts.
	Cotoran+Dual	1,0kgs.+3.0 "	Galecron	0.5 lts.			Bayfolan	2-3 lts.
	Tomilon	3.0lts.	Tox-DDT-40-20	1.0 gal.			Nitrofoska	2-3 lts.
	Prowl	3.0lts.	Lannate	300 grs.			Cloruro de K	3 libras
	Anzar 8.100+							
	Karmex	1.5kgs.+0.8 "	Dimecron 100	200 cc.			Escorias Thomas	300-500 kgs.
	D.S.M.A.	2.0-3.0 kgs.	Arseniato plomo	6.0 lbs.				
			Nuvacron 40	3.0 lts.				
			Nuvacron 60	1.0 lt.				
			Ciyard 630	3.0 lts.				
			Vicsametil 4-1-4	1.0 gal.				
			Tamaron	3.0 lts.				
			Sicarol	500 cc.				
			Dilel	0.5-0.7kgs.				
			Trichogramma	1.0-1.5 pulg.				
			Cutvel 3 E.C.	1.5 gal.				
			Bolmark	500 cc.				
			Metilparation+ T.DDT-40-20	0.7+1.0gal.				
			Metilparation+ Lannate	0.7+150grs.				
			Metilparation+ Azodrin	0.8+1.0lts.				
			Metilparation+ Galecron	0.6+0.4lts.				
			Metilparation+ Bolmark	0.5+0.5lts.				
			Aldrin 2.5%	25 kgs.				
			Cutvel	25 "				
			Fedoton	2-3 lts.				
			Sevin 80	1-2 kgs.				
			Profiton	0.6 "				
			Toxametil	2-3 lts.				
			Cebiran	25 kgs.				
			Azodrin	1 lt.				
peanut	Treflan	3 lts.	Etil Paration	2 lts.	Dithane M-45	4 lbrs.	15-15-15	50 kgs.
	Vernam	1 gal.	Azodrin	1 lt.	Mancozeb	4 lbrs.	Cal	300-1,000 kgs.
	Lazo	1 gal.	Lannate	200 grs.			Cloruro de Potasio	75 kgs.
			EPN	1 lt.				
potato	Afalon 50	2 kgs.	Malathion 57%	1 lt.	Manzate	1,5-5 kgs.	10-30-10	900-1,000 kgs.
	Lorox	2 kgs.	Roxion	1 lt.	Dithane M-45	1,5-5 kgs.	6-38-6	1.000 kgs.
			Furadan 3%	18-25 kgs.	Brestan	0,4-0,5 kgs.	10-20-20	1.100 kgs.
			Aldrin 2,5%	4 lts.	Duter 20%	1 - 2 kgs.	13-26-4	1.200 kgs.
			Timek 10G	2 lts.	Oxicloruro de Cobre	2 kgs.	Foliares	Varios
			Metil Paration	1 lt.	Benlate	300 grs.		
			Aldrin 2.5	2.5 kgs.	Zineb	2 kgs.		
			Ekatin	1 lt.				
			Carbofuran	20 kgs.				
			Dimecron 50	0.5 lts.				

Table 12 (continued).

Crop	Herbicides product	Herbicides dose	Insecticides product	Insecticides dose	Fungicides product	Fungicides dose	Fertilizers product	Fertilizers dose
rice	Preforan	1 lt.	Dimecron + Metilparation	0.5+0.5 lts.	Bla-S	1 lt.	Urea	200-400 kgs.
	Stam F-100	2-3.5gal.	Sevin 80+Metilparation	2.5kg.+3lts.	Hinosan	0.75-1 lt.	Kcl	1 bulto
	Stam+Fedearros +toxafeno *	2gal.+500cc. + 1 gal.	Furadan+Azodrin	1.5+0.5 lts.	Hinosan+Bla-S	0.3-0.5+ 0.5-0.6 lts.	Urea + Kcl	1.5-2+1- 1.5 bultos
	Stam+Fedearros +T[illegible]eno *	[illegible] +1 gal.	Anikil	2 lts.	Hinosan+Antracol	1 lt.+1.5- 2 Kgs.	(25-15-0)+Kcl+Urea	2+1+1/3-½ "
	Stam+Torsone+Toxafeno*	2.5gal.+500cc + 1 gal.	Dipterex SP-80	1 kgs.	Hinosan+Antracol+ Bla-S	0.31+0.5 lt.+ 1 kg.	Urea+Kcl+Map.	1.5+2 "
	Stam+Toxafeno+Anikil *	2 + 1 gal. + ½ lt.	Dimecron 100	250-300 cc	Hinosan+ Dithane M-45	1 lt.+ 6 lbrs.	Foliagro	1 gal.
	Stam+Toxafeno *	2 gal. + 300cc	Toxafeno DDT 40-20	1 - 1.5 gal.	Hinosan+Thimeth **	1 lt.+ 1 lt.	Nitrofoska	30 lts.
	Saturno Plus	2-2.5 gals.	SPM	1 lt.	Hinosan + Dimecron **	1 lt.+ 0.9 lt.	Compuestos	200 - 250 kgs.
	Colonil	0.5 gal.	Toxafeno 60	1-1.25 gal.	Hinosan + Endrex **	1 lt.+ 3 lts.	Sulfato de Amonio	100 -200 kgs.
	Fedearros 500	1 -1.5 lts.	Calbane	1-1.25 gal.	Hinosan + Cigard **	1 lt.+ 2 lts.	Celjep	1 Kg.
	Stam 100 + Saturno	1 + 2 gals.	Cidial	2 lts.	Hinosan+Dithane+Lebaycid**	0.8-1 lt.+5-6 lbrs.+ 1 lt.		
	Stam F-34	3 - 4 gals.	Azodrin	1 lt.	Kasumin	1 - 2 lts.		
	Machete	10 gals.	Aldrin 2.5	25 kgs.	Bavystin	200-300 grs.		
	Esteron 47	2 lts.	Parathion	1 lt.	Dithane M-45	2.5 - 5 kgs.		
	Propenil	5 gals.	Furadan 4F	1.5 lt.	Benlate	200 grs.		
	Basagran	1 lt.	Bux 360	1 lt.	Kitosin	1 lt.		
	Aretit	1.5 lts.						
	Tormona	0.5-0.7 lts.						
sorghum	Gesaprim	2 - 3 kgs.	Nuvacron	700 cc.	Dithane M-45	3 kgs.	10-20-10	150 - 200 kgs.
	Triazol 80	1.5-2 Kgs.	Azodrin	0.5 lts.	Kasumin	1 lt.	Urea 46%	100 - 150 kgs.
	Atrazine	1.5 kgs.	Etil Paration	0.5 lts.			Foliarea	2 lts.
	2-4-D	1 lt.	Dipterex	1 kgr.			Escorias Thomas	300 - 500 kgs.
	Esteron 47	1 lt.	Basudin	0.3 lts.			Cloruro de Potasio	50 - 100 kgs.
	Coltrasina	1.5-2.0 kgs.	Lannate	150 grs.			15-15-15	100 - 150 kgs.
			Sevin	2 kgs.			Bayfolan	3 lts.
			Cebiran	0.6 kgs.				
			Aldrin 2.5	25 kgs.				
			EPN-45	1 lt.				
			Azodrin	1 lt.				
			Sevimol	0.7 gal.				
			Etil paration	1 lt.				
			Parathion	0.7 gal.				
			Triclorfon	1 kg.				
			Cutvel 5%	25-30 kgs.				
			Cebiran G	15-22.7 kg.				
			Dipterex G	15-22.7 kg.				
			Triclorfon G	20 kg.				
			Cebicid G	20 kg.				
			Toxafeno DDT 40-20	1 gal.				
			Heptacloro	20 kgs.				
			Bux 360	2 gals.				
soybean	Lazo	3 - 5 lts.	Metil Paration	2 lts.			Urea como correctivo.	
	Sencor	0.6-1.5 kgs.	Tamaron	2.5 lts.				
	Surflan	0.9-2.3 kgs.	Sevin	1.5 kgs.				
	Prowl	3 - 4 lts.	Azodrin	1 - 1.6 lts.				
	Dual	2 - 2.5 lts.	Lannate	0.3-0.4 kgs.				
	Cobexo	6 - 7 lts.						
	Treflan	3 lts.						
	Basagran	2 - 2.5 lts.						
	Lazo+Sencor	1 - 3 lts.+ 0.6-1.5 kgs.						
	Prowl+Sencor	2 - 4.4 lts.+ 0.5 - 1 kgs.						
	Surflan+Sencor	1 -2.3 lt.+ 0.5-1.4 kgs.						
	Sencor+Dual	0.6-1.2 kgs.+ 2 - 3 lts.						
	Afalon+Sencor	3 lts.+0.8 kgs.						
	Prowl+Basagran	1.2+ 2 lts.						
	Cobexo+Sencor	5 lts.+0.8 kgs.						
wheat	Esteron 47	2.3 lts.					10-30-10	150 kgs.
	Caretox Ester 3.34	2.3 lts.					13-26-4	150 kgs.
							15-15-15	150 kgs.

Corn whorls are often hand treated with carbamates or phosphates for control of Spodoptera frugiperda. Beans and soybeans have several pests that are currently controlled by insecticides. Table 13 gives these pests, their estimated economic injury levels, appropriate insecticides and minimum dosages. Table 13 was developed for an insect pest management program on soybean in the high selva of Peru under the USAID/INTSOY program. Sugar cane does not receive insecticide applications; pests of this crop are maintained below economic thresholds by biological control agents.

Fungicides. The Dithiocarbamates such as zineb and maneb made up the largest segment of the fungicides. Agricultural oils, benomyl and many others made up the rest. Rice, vegetables, potatoes, bananas and other tropical fruits are probably the crops most commonly sprayed with fungicides.

Large plantings of rice are sprayed by air and large farms use some tractor drawn sprayers. However, knapsack sprayers are used on small farms and many large farms for pesticide application.

Herbicides. Pichloram (Tordon), 2,4-D,2,4,5-T and dicamba made up nearly half of the sales volume of herbicides used in Colombia. Most of these plant growth regulator herbicides are probably used on pastures and rangelands. The photosynthetic inhibitor herbicides were next in volume dominated by propanil for rice, atrazine for corn and sugar cane, fluometuron (Cotoran) for cotton and bentazon (Basagran) for soybeans. Other herbicides of importance were metolachlor (Dual), Paraquat, Glyphosate (Roundup) and trifluraline (Treflan), Glyphosate is a new herbicide with great potential in the tropics. Use is increasing rapidly.

CATIE report entitled "Informe Resumido de la Encuesta Preliminar" gave the results of a survey of farmers in three Central American countries. In Costa Rica, four of five regions surveyed showed 63% to 97% of the farmers were using herbicides. In the fifth region, which is on the South Pacific side and is very primitive, only 7% reported using herbicides. In Honduras, two areas surveyed showed 50% to 60% of farmers used herbicides. In Nicaragua, two regions surveyed showed no herbicides used. The average farm size in the regions surveyed was 6.5 to 17.7 hectares. In Guatemala, we observed little or no herbicide use nor heard about it. In Costa Rica where herbicides are about the same price as in the U. S., herbicide usage was observed and discussed with CATIE staff. In Guatemala and some other Central American countries, the cost is higher than in the U.S.A. due to import duties.

Table 13. Insect pest, economic injury level, insecticide and dosage for insect pests in the high selva of Peru.

NOMBRE		DAÑO ECONOMICO			INSECTICIDAS Y RECOMENDACIONES (gramos/ha)	
común	científico	estado	No/M surco	daño	Ingrediente activo	Producto comercial
Gusano defoliadores Caballada	Anticarsia gemmatalis	larvas mayor de 1.5 cm	20	15% defoliación	500 carbaryl	600 Sevin S-85
Medidor	Pseudoplusia includens				500 methomyl	600 Lannate 90 polvo mojable
Ejercito	Spodoptera sunia Spodoptera frugiperda				1000 carbaryl	1200 Sevin S-85
Escarabajos de hoja	Cerotoma fasciata Cerotoma tingomariensis Diabrotica spp. Colaspis spp.	adultos	20	20% defoliación	750 carbaryl	900 Sevin S-85
Gusano cortador	Spodoptera eridania	larvas de cualquier tamaño		40% plantas atacadas	600 methyl parathion	1200 paration
Picador del tallo	Elasmopalpus lignosellus				500 methyl parathion	1000 paration
Cerambycido	Grammopsoides sp.				500 methyl parathion	1000 paration
Gusano pegador	Hedylepta indicata	larvas de cualuqier tamaño		50% plantas atacadas	750 carbaryl	900 Sevin S-85
Barrenadores de tallos y brotes	Epinotia aporema Laspeyresia leguminis Cryptophlebia sp.	larvas de cualquier tamaño		40% plantas atacadas	1360 carbaryl 1000 carbaryl 1000 carbaryl	1600 Sevin S-85 1200 Sevin S-85 1200 Sevin S-85
Barrenadores de vainas	Epinotia aporema Laspeyresia leguminis Cryptophlebia sp.	larvas de cualquier tamaño		10% vainas atacadas	1700 carbaryl	2000 Sevin S-85
Chinches	Nezara viridula Piezodorus guildinii otros especies	adultos y nimfas mayor de 0.5 cm	2		600 methyl parathion	1200 paration
Aranitas rojas	Tetranychus urticae	cualquier		inician focos de infestacion	420 dicofol	1000 kelthane
Acaros tostados	Poliphagotharsonemus latus				735 dicofol	1750 kelthane

In Peru a group of agricultural chemical company representatives estimated that the annual sales of all pesticides are between $12-14 million. Approximately 50% is insecticides, 30% herbicides and 20% fungicides. Nearly all sugar cane is treated with herbicides and grown on a no-till system. Triazines, asulam, 2,4-D, 2,4,5-T, picloram and dalapon were mentioned as important herbicides used for this crop. Rice is the second most important crop in terms of herbicide use. Propanil, benthiocarb, butachlor, oxadiazon and "Avirosan" were mentioned as important. They estimated about 70% of the coastal rice is treated with herbicides. Coffee is grown under no-till with paraquat being the most widely used material. Cotton is mostly hand weeded. Cooperatives with plenty of hand labor grow about all of the cotton. Perhaps 10% of the acreage is treated with trifluralin. Herbicide use is limited in cotton due to no irrigation for 30 to 45 days after planting which makes preemergence materials ineffective. Incorporated herbicide use is limited due to poor equipment for this purpose. Perhaps 50% of the corn grown on the coast and practically none in the rest of Peru is treated with herbicides (mostly atrazine and 2,4-D). Herbicide treatment of other crops is very limited.

Herbicide Application. Most herbicides used on small farms in Costa Rica are applied with knapsack sprayers. An adjustable nozzle shield has been developed at CATIE that makes directed sprays in low growing annual crops such as beans feasible (M. Shenk, personal communication). In fact, we visited one farmer who had had excellent results with it in beans. Half of the field was hoed during wet weather, the other half sprayed with directed paraquat; the farmer said the latter treatment increased the yield by 70%. Part of the increase was due to less bean rot in the clean area (paraquat treated).

The latest and most exciting innovation in hand herbicide application equipment is the "rope wick" or "weed wiper". In this method, a plastic pipe is used as a handle and herbicide reservoir and another cross piece as reservoir and applicator. The latter is fitted with nylon ropes or a piece of rug, etc. which is kept wet by capalliary action with a concentrated solution of glyphosate (Roundup). The weeds are then "wiped". Control has been good; this method eliminates the major constraints to herbicide use by small farmers which are:

1. The need for carrying large volumes of water.
2. Spray drift.
3. Cost of sprayer.
4. Cost of herbicide.

The amount of the water used is small; drift is eliminated, the applicator cost is 10-20% of a knapsack sprayer and, due to greater efficiency, less herbicide is needed per hectare. The latter is probably due to less being wasted by spraying bare ground between weeds and lost as drift. CATIE is using this new application method and results we observed were good.

In Peru, a variety of application methods are apparently used for herbicides depending on farm size. However, small farmers use knapsack sprayers. It was interesting to learn that Roundup is being used for spot treatment of weeds in sugar cane with a modified backpack applicator. The spray nozzle is removed and a sponge and brush arrangement is kept moist with a solution of one part Roundup to 15 parts water. The weeds are then "brushed" with herbicide. This is an independent invention of a system related to the "rope wick" or "carpet wiper" applicators, mentioned above. However, the latter are cheaper, simpler, and use less water.

Cesar Valles at Tarapoto, Peru, spent last summer in Illinois and had seen the rope wick applicators. He had found that two men could carry one that was designed for tractor mounting. By walking down the rows and holding the applicator above the crop they were able to control tall weeds without damage to the crop.

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CROP PROTECTION COMPONENTS AND THEIR STATUS IN LATIN AMERICA

Crop protection can be thought of as being composed of many components, all of which, taken together, provide the knowledge and resource bases necessary to implement ecologically sound pest management programs. These components include: 1) protection problem identification, 2) research directed toward solving the protection problem or problem complex, generating technology, 3) a reliable and dynamic delivery system capable of mobilizing the technology and getting it to the small farm systems, 4) an adequate cadre of trained personnel to accomplish components 1 through 3, and 5) the necessary equipment and supplies to provide backup for components 1 through 4 above. Inherent in the component sytem is a feedback mechanism capable of relating new protection problems to the researchers, usually via outreach or extension, and conveying new technology generated to the farmer, also via the delivery system. Thus, the delivery system is the lifeline of any pest management program, and it would be unwise to contemplate implementation of IPM without serious consideration of a strong, viable extension component. Superimposed on these complex and interrelated components are the economic, social, and political climates that, when favorable, can do much to drive and sustain IPM programs. The team has reviewed many of these components in the countries visited in Latin America. There are strengths and weaknesses among them.

Protection Problem Identification

Problem identification, itself, involves several subcomponents: gathering biotic agents responsible for crop damage, having the agents identified, searching the literature for relevant articles dealing with the biology and control of the agent, and having this information transferred to the researcher (component 2 of the series).

With weeds, fungi, bacteria, and vertebrates we found almost no problem in the countries we visited regarding the gathering of the causitive agents or their subsequent identifications. Researchers for the most part, even in the more remote areas, were aware of the pathogenic problems. With insects, nematodes, and viruses the reverse was true: biota was often not gathered and identifications difficult to come by. Many researchers were calling herbicide injury virus-induced while many virus problems were diagnosed as nutritional deficiencies. Nematodes and the crop damage they caused were largely ignored (although we viewed two nematode diagnostic centers in Peru) by farmers.

The insect gathering and identification phases were especially dismal. Outside of a few well known and polyphagous species, almost none of the insect pests, let alone the beneficial fauna, was known by researchers away from large research facilities. And even at the larger research facilities, very little emphasis was placed on gathering material and getting it identified to provide names for searching the literature.

For instance, Guatemala has virtually no capacity to identify insects, viruses, or nematodes. Costa Rica has some ability, especially in the latter two categories, but lacks the infrastructure to identify insect pests from crop fields. Colombia has excellent capability to identify viruses, nematodes, bacteria and fungi, but has little ability in the realm of insect identification. Peru has some capability to identify nematodes, pathogens, and viruses, but very little expertise in insect identification.

The entomologists at CATIE, Turrialba, are trying to build an insect identification service capability into the center. They have built up a reference collection of ca. 10,000 identified specimens representing about 800 species, approximately 10% the number they feel they need to be able to provide most of the identifications of crop associated arthropods from Central America. Furthermore, they estimate that in Central America most identifications (ca. 80%) are made from pamphlets or by word of mouth; often the pamphlets were made in the USA and the identifications are nearly meaningless and could be very misleading. Approximately 10% of the identifications are made by national staffs, usually university and Ministry of Agriculture personnel with another 5% of the identifications handled at CATIE.

The remaining 5% are currently sent to the USDA Systematic Entomology Laboratory in Beltsville, MD where they are processed, given a name. The name, often the specimen too, is returned to the sender. This 5% adds to approximately 30,000 identifications made by the Systematic Entomology Laboratory each year for just Mexico, Central America and South America (L. Knutson 1980, letter to R. H. Gonzalez, Appendix E-1). With the increasing load of identifications from the U. S. and decreasing resources to meet these increases, it is possible that the Systematic Entomology Laboratory will have to restrict the submission of insects for identification from outside the United States. Since Latin American scientists rely heavily on these 30,000 identifications per year for proper determination of pests and beneficials, a cut back, rather than expansion, of proper identifications would likely result in a worsening of IPM practices throughout Latin America. Peru has plans for 5 diagnostic centers, but these will not handle insect identifications.

What is needed, according to Lloyd Knutson, head of the Systematic Entomology Laboratory of the USDA, are some clearing centers for insect identification, centers with medium-sized reference collections and appropriate literature that can serve as identification centers for large regions. Only the insects that can not be readily identified at that level would be sent to the USDA. Dr. Knutson feels that one such center in Central America plus one or two in South America could serve Latin Americans well. He feels it would reduce the identification load for the USDA yet make their role in the process more uniquely important. Meanwhile, such centers in Latin America will serve, with some needed publicity, to properly identify a much larger percentage of what should be determined in the field. According to CATIE entomologists, about 95% of the insects that should be identified or verified are not; their names are merely guessed at in the field. Such centers would also stimulate research on many economically important groups of insects that currently are poorly know in Latin America.

For each of these centers, it is felt that one full-time curator/identifier is needed on hard money, plus a rotating post doctoral position in insect systematics, and a full-time assistant to handle the pinning, packaging, and technical aspects of the collection. There would also be a need to gather relevant literature for each regional center. Todd (Appendix E-2) in a document on "survey of collections, entomological libraries and taxonomists in Central America and Panama, and recommendations bearing on the possible establishment of a regional insect identification laboratory" recommends various equipment and supplies for such a center, although he considered a professional and supportive staff far larger than we do. Knipling (1964) (Appendix E-3) proposed an Inter-American insect identification project that involves training for identifiers. This and other areas of training is a resource base we will discuss later.

What is important is that some consideration be given to development of diagnostic centers, because proper problem identification is fundamental to control situations.

Also important in this component is the search for and acquisition of appropriate literature on the identified pest. There are many computerized literature banks around the world, but access to these takes a knowledge that they exist and the minimum cost of user fees; also there is often the cost of photocopying pertinent articles.

Drs. L. Knutson and J. Lattin have conducted a detailed survey of taxonomic service needs in Latin America, the results of which will be published soon. Anyone wishing to pursue this issue further should read the above mentioned report.

Research Directed Toward Solving Protection Problems

Once a pest organism has been identified and all pertinent literature gathered and digested, the research must look for ways the pest can be managed (controlled). The options are many, but the modern researcher will first study the pest, understand its life cycle and ecological requirements before attempting to devise control measures. What are its alternate hosts? What causes epidemics? How can one best sample the pest? What is the economic injury level of this pest on this crop? Is it in fact causing economic damage? What is its phenology? What are its natural enemies and all other factors reducing its numbers and spread? These types of questions should be answered, at least in part, before a serious attempt is made to discover a control.

At the onset a chemical control tactic should be found and tested: what chemical will lower the pest's population levels without greatly upsetting population levels of beneficial organisms, and is the pesticide aggravating other pest problems? This chemical, once tested, will provide a backup to control the pest if populations get out of hand.

The researcher should look for weak points in the life cycle and for peculiarities in habitat requirements. These could provide clues towards devising long-lasting, economically sound and environmentally safe control measures. Tactics, especially host plant resistance, biological control, and cultural control, should be explored, and once a tactic or a combination of tactics are experimentally found effective in keeping population levels of the pest below economic thresholds, the technology package should be assembled and passed on to the extension personnel, people who can deliver the technology to the small farm situation.

The research component in ICP in the Latin American countries we visited were, on the whole, fairly good. Guatemala had an intensive series of programs at ICTA aimed for improving technology for small farm situations. The research staff at ICTA, Guatemala, was very over-extended and inadequately supplied and equipped, but the researchers we visited were well trained and aware of their important mission.

At CATIE, Costa Rica, researchers were of international caliber and the ICP research they were conducting fit neatly within their cropping systems approach. At the University of Costa Rica, the ICP research we saw was mainly aimed at virus control with a lot of work in the area of seed quality. What they were doing was excellent, but the balance was heavy on Plant Pathology.

In Colombia, the ICA research staff seemed excellent, especially in the area of Plant Pathology. Advanced training in nematology was in progress to strengthen needed nematology programs. Little effort was expended in weed science and entomology. In entomology the problem areas are so numerous and diverse that the small staff, including the Tibaitata and Palmira Experiment Centers, was insufficient to successfully cope.

In Peru, the ICP researchers at INIA, La Molina, were few, for the most part need additional training and increased incentive to more field work. There were notable exceptions including Ings. Delgado, Avalos, and Herrera; and the research effort at CICIU was outstanding, given the poor resources they have at their disposal.

The INIA experiment station at Tarapoto was also understaffed scientifically. The Tarapoto area has the worst weed problems we saw on the trip; yet no weed scientists are currently stationed there.

The experiment station in Chiclayo, responsible for the entire northern part of Peru, had very few professional scientists in the area of ICP. The few they had were of high quality. They assembled a bean virus group between INIA and the university at Lambayeque; the entomologist at INIA is doing excellent work but is overpowered by the problems with which to cope. They badly need more personnel in nematology and weed science on their staff.

INIA at Cuzco is very understaffed, with only a single entomologist, we met no other plant protection personnel at INIA-Cuzco. The research Ing. Yabar, the entomologist, is undertaking is of excellent quality, especially considering the number of problem areas he must cover.

The agricultural university at La Molina (UNA) is without doubt the prestige institution in Peru for research in ICP. The staff includes 10 entomologists (3 Ph.D., 6 M.S., 1 Ing. Agron.), 6 plant pathologists (2 Ph.D., 4 M.S.), 2 nematologists (1 Ph.D., 1 M.S.), 1 weed scientist (Ph.D.), 1 ecologist (Ph.D.), and 2 biologists (Doctorates). Research is excellent in all areas, and UNA is particularly strong in the area of entomology. The national corn and small grains programs are located at UNA.

Universidad Nacional Pedro Ruiz Gallo at Lambayeque has fewer staff in ICP but has rather interesting student projects dealing with the major crop protection problems in the area. Dr. Panizo, Director of Research, is intensely interested in research-related activities for his staff.

The international agricultural research centers (CIAT, CIP) have excellent research scientists and programs, especially in the area of plant resistance to pathogens and, more recently, insect pests. Their cropping system involvements in ICP are minimal at this point.

Our feelings are that research in the area of crop protection is probably the strongest of all of the components herein mentioned. It definitely could use some help (and this will be discussed below), but it is proceeding ahead of the other areas on its own.

Two categories of researchers that were noticeably lacking at all national institutions in the countries visited were agricultural economists and agricultural anthropologists/sociologists. The former category is particularly important at the experimental production level because economists are able to weigh alternative approaches on a cost analysis basis and determine which alternatives are viable, and optimal with given production constraints. The latter category is important to help make decisions of a social nature that could affect entire cropping systems and research approaches to them.

In the short run, efforts to overcome the inavailability of trained agricultural economists must be made through short course training of crop production researchers in the basic use of analytic economics. In the long run, increased emphasis should be committed to strengthen national programs by bringing Ph.D. level agricultural economists on the staff. Also, training of agricultural economists should be intensified, especially at the University of Costa Rica and at UNA, La Molina. Salaries must be made more attractive to hold these specialists in research positions. Losses of trained professionals from national institutions to the private and other governmental sectors has been extreme; in Colombia, for example, only about 10% of the Ph.D. agricultural economists trained in the past 15 years by ICA are still with the institution.

It is obvious that any Title XII endeavors in Latin America will have to bring their own sociologists and economists to meet their own short term needs.

Delivery Systems for Transfer of Scientific Agricultural Technology

The transfer of scientific agricultural technology from the research scientist to the small farmers in Central and South America has been a major problem for a very long time. The small farmer does have "input" into his farming practices; however, it is usually not from the national university, research, or extension scientist who is developing technology that could benefit him.

Some of the sources of information on "input" for the small farmer are the following:

1. Tradition and cultural background play a vital role in establishing the framework of operation for the small farmer. His father and grandfather have taught him what he knows about farming and to radically change his way of doing things would create great inner conflict unless he is convinced it is the right thing to do. Since, for the most part, his farming is subsistence and a crop loss means hardship for his family, the farmer is more likely to stay with that which is comfortable for him and he has worked with in the past. Certainly many of the agricultural practices which the farmer received from his ancestors are sound and effective. Others are less desirable, for example, in the highland areas of Peru the farmers traditionally have favored a dark potato. This continues to be true even though there are light colored potatoes which are comparable in taste, better for storage, more productive and more resistant to many virus diseases.
2. Neighbors and other farmers are the source of input to the small farmers which often involves peer pressure and can strengthen old traditions and cultural practices making the acceptance of new agronomic technology more difficult. In some cases, however, peer pressure has been directed toward new technology.
3. Agricultural chemical company representatives or salesmen often are able to have input into the farmers agronomic practices because they have a product which can often quickly and effectively bring insects, weeds or diseases under control. Unfortunately, in many cases the farmer

is not aware of the ramifications of excessive pesticide use. There have been serious examples of misuse (i.e. excessive levels of application and careless handling of the pesticide) resulting in hazards to the small farmer and his environment.

4. Extension and rural development specialists are a source of input for some small farmers; however, the availability, acceptance and use of these organizations vary from country to country. In some countries extension works with the bank loan system to bring about farmer use of new technology. The small farmer in this situation may be refused a loan if he does not carry out certain farming practices in tilling the land before planting. Unfortunately, this system has in some cases become political and the small farmer is hurt in the process.
5. The media of radio, television, newsletters, brochures, and/or a van equipped with audio-visual equipment have made information available to the small farmer. One very successful example of the use of radio was found in Northern Guatemala where a three year study supported by AID was made. A series of well done radio programs including agriculture were aired for several hours each day. By the end of the study 85% of the small farmers of the area were listening to the program.
6. Demonstration plots, field days, producer or farmer meetings, individual farm visits and short courses run by university, research or extension have stimulated some farmers to accept new technology. According to an extension worker in the highlands of Peru, one of the most effective means of encouraging farmers is to have them come together and talk together.
7. Cash crops such as coffee, cotton, rice and sugar cane often have organizations or associations which will make technical services available to growers. The technician or representative of these associations can and often does have significant input into the small farmers practices for these crops. This was particularly noticed in Costa Rica, Colombia, and Peru.

Some of the reasons or hindering factors that may be preventing the effective flow of this information are the following:

1. The researcher, who is academically trained, comes primarily from a family with financial means in the urban environment. As a result he has difficulty relating to the "compensino's" socio-economic situation.
2. Many researchers and those trained to communicate research information have had little experience with the small farm and therefore lack confidence in knowledge of the farm activities. The small farmer senses this very quickly and has little or no confidence in the researcher or his team. For example, in one country visited, a trained research technician came to the farmer to help him learn some new agronomic practices. Initially he was helping the farmer break the corn so it would dry in preparation for harvest and so beans would grow up the stock. The technician broke the corn exposing the ear. The farmer, as a result, lost confidence in the technician and his new techniques because surely anyone who knew farming would not expose the ear of corn to damage by birds, rain, and disease. This error made it difficult for the technician and the researcher to communicate new technological information to the farmer.
3. Much of the research technology has not been tested on the small farm situation with its varying conditions. A number of failures at the farm level with technology that worked well at the experiment station have left many farmers skeptical of research "advances".
4. The pressure for new technology is often not felt by the small farmer. As an example, a difference between the small farmers in Costa Rica and those in Guatemala was observed. Costa Rica has a low rate of unemployment as compared to Guatemala which is considerably higher. Farmers in Costa Rica were very interested in labor saving herbicides or other labor saving techniques because of the shortage of workers while the Guatemalan farmers were not feeling that pressure.
5. The small farmer is often insensitive to the interests and activities of the researcher. A researcher with test

plots on a small farm may become frustrated by rapid and frequent changes such as the plowing of his no-till experiment. A researcher may become discouraged and question the advisability of working with the small farmer.

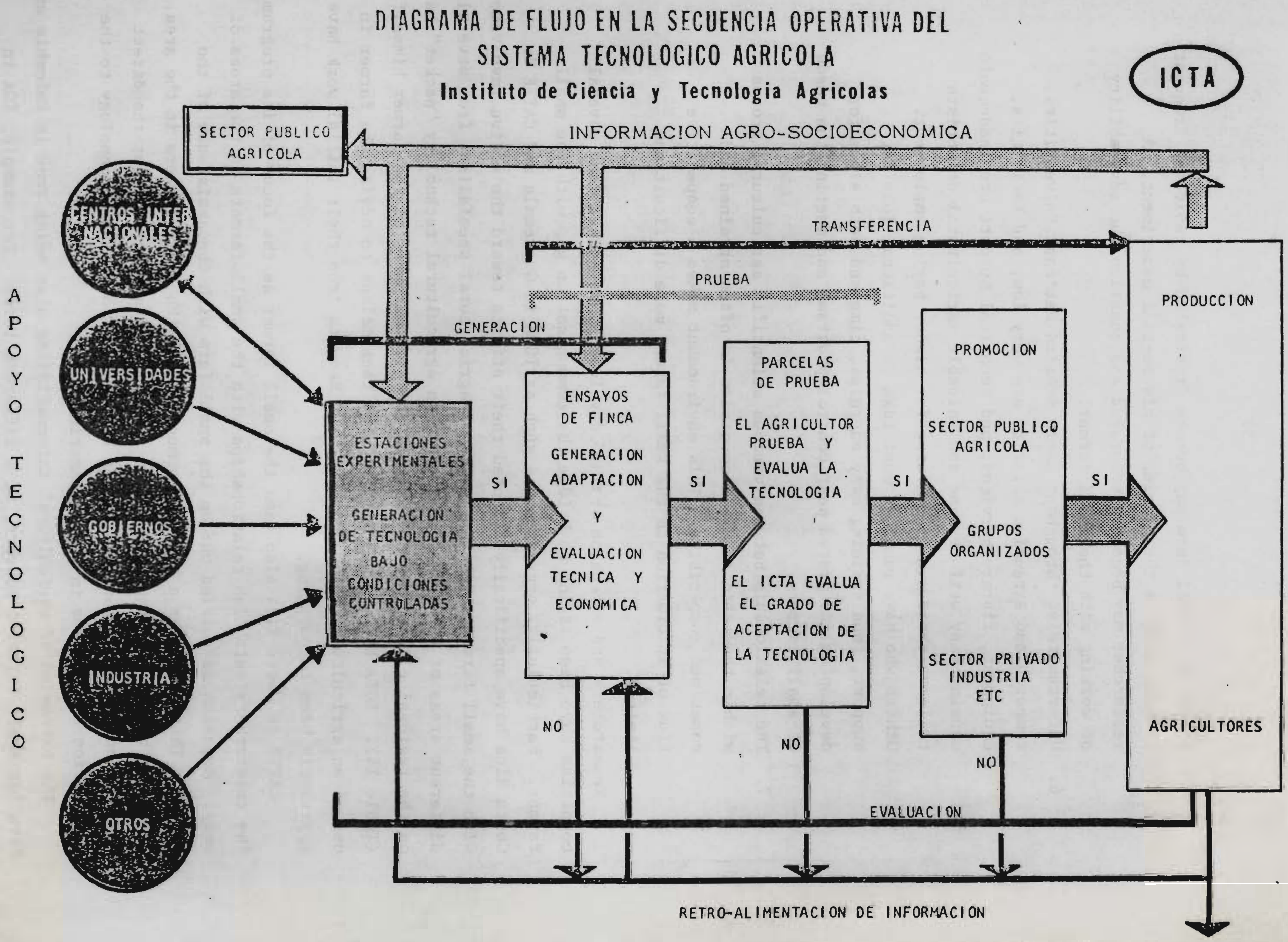
6. Unfortunately, throughout Latin America National Universities, research and extension salaries are very low, and facilities, equipment, library services, and technical support are inadequate causing many well trained and valuable agricultural scientists to leave their area of training for higher paying employment. Others who have remained must take on additional jobs for support, thus draining away energies, time and enthusiasm for developing integrated pest control programs and meeting the needs of small farmers.
7. The relationship between various scientific agricultural groups within the Latin American countries is often strained and sometimes competitive. This environment makes a cooperative flow of information to the small farmer more difficult and limited.

Researchers and extension or rural development personnel from several countries have been trying to bridge the communication gap with the small farmer. Particularly, organizations such as ICTA in Guatemala and CATIE in Costa Rica have specifically directed their efforts toward the active involvement with the small farmer. ICTA has teams of agricultural specialists from several different areas of expertise formulating an agricultural technology "packet" based on the regional climatic conditions and the circumstances of the farmer himself (Table 14). ICTA has trained agricultural technicians to advise the farmer in the use of an agricultural technology packet. Results from their initial work have apparently been encouraging.

CATIE in Costa Rica also uses the small farmer as the focus of its programs. The researchers establish relationships with the small farmers in the areas of need. Research is carried out on the small farm with the assistance of the farmer. This has given a base of communication with other farmers in the area. CATIE has been very encouraged by the results of its programs, but the direct interaction of researcher with farmer cannot hope to deliver technology to the 6-8 million small farms in Central America.

The extension of agricultural information is also being done in Colombia and Peru for small farmers; however, at a different level. For example, ICA in

Table 14. Diagramatic flow of the sequence of technology evaluation and transfer at ICTA, Guatemala



Colombia has a section of its organization given to the communication of agricultural information. Different avenues of communication have been explored and analyzed by this group.

The extension service of the Ministry of Agriculture in Peru that recently was joined to the nation's research division, INIA (Appendix F), has for several years been severely limited by lack of funds and personnel. In the midst of these circumstances they have been able to use field days, short courses, special information bulletins and develop some "packages of technology" for the farmers. There is a new enthusiasm among the extension people that new opportunities are before them.

The opening of the communication avenue to the small farmer in order to transfer agricultural technology at a meaningful and useful level is important though often difficult. As a result of discussions with scientists, small farmers and others in the four Latin American countries visited (i.e. Guatemala, Costa Rica, Colombia, Peru) the following suggestions surfaced:

1. Develop and maintain a good working communication and confidence relationship with the small farmer.
2. Develop an understanding of where the farmer is in relation to his problems and how and where improved technology could assist him.
3. Technology should be tested at the small farm level in the heart of the problem areas with the farmer being a part of the management procedure. This would include keeping the farmer informed of what you are doing and why.
4. Develop a specific technology package for the small farmer in an area; taking into account the cultural, traditional and environmental conditions which surround him. It is important to continually be alert to the things that are accepted or rejected by the farmer and why they are accepted or rejected so that revised technology packets can be made.
5. Demonstration plots, field days, farmer meetings and short courses can also serve to effectively communicate new technology.
6. Radio, television, cartoons, pictured stories dramatizations, simple brochures and other such means when properly used are very effective. For example, nearly every small farmer will have a radio and there is a wide variety of programing

which can be used to communicate with the small farmers.

7. Communication should be directed to the entire family. Many decisions are made by both the husband and wife. In some areas effective communication has been made to the small farm family through the children in grade school.
8. Communication can be directed through the priest or religious leader of the community.
9. In certain situations a priority for receiving loans if certain agricultural practices are used may be a means for having farmers try new technology; however, this would have to be carefully monitored.

The effective delivery of scientific agricultural technology to the small farmer has been limited; however, there have been successes and there have been failures. Both can be learning experiences in formulating new directions.

Capacity for Latin American Institutions in Integrated Pest Control

Educational opportunties are presently available for advanced study in Integrated Pest Management in several institutions in Latin America. These include CATIE, in Costa Rica, University of Costa Rica, ICA in Colombia and the National Agricultural University of UNA of Peru.

There are some serious constraints on the development and expansion of effective IPM programs for advanced degrees in these institutions. For example:

1. Low faculty salaries have caused an exodus of very capable and qualified people to other areas and the staff remaining are taking extra jobs to supplement their income causing pressure and competition for time, energy, and interest.
2. Faculty teaching loads are excessive.
3. Faculty are often required to teach in areas for which they have no background or interest.
4. Inadequate equipment, facilities, and library support.
5. Many staff personnel have received advanced degrees in U. S. or Europe and are not familiar with pest problems in Latin America or the limitations of equipment etc. to study those pests.

Training research, extension and university scientists in the area of Pest Management in Latin America is important. This allows research study interests to be established in the setting of which they will work.

Emphasis will need to be placed on the adjustment of some of the constraints mentioned above so that a more effective post graduate program can be developed for Integrated Pest Management.

A draft proposal (Appendix G) has been circulated through portions of AID for funds to develop UNA, La Molina, into a first rate post-graduate training facility in ICP for upgrading the level of training in ICP personnel at INIA and various institutions in the Andean Pact countries. The Title XII ICP program, we feel, should get solidly behind these efforts, for without them the prospects of a long term, self sustaining effort in ICP in those countries stands far less a chance of success.

Research Facilities, Equipment, and Supplies

In general, research support areas (facilities, equipment and supplies) were found poor and inadequate. This was especially true of transportation to get research and support crews to the field where the problems exist and where experiments must be conducted. This problem was universal. Even when transportation equipment was present, money for gasoline was not, making the vehicles useless. A good number of vehicles and other equipment was useless because they lacked spare parts. The idea of having one's experiment fail because the institution could not or would not allocate money for gasoline must be extremely discouraging and frustrating to the researchers. Beyond this small description, the section on institutions will cover major aspects of researcher and extension backup.

INSTITUTIONS AND POTENTIAL COLLABORATION WITH ICP TITLE XII PROGRAMS

Several factors should be considered when contemplating collaborative programs between U. S. universities and institutions of developing nations. Beyond the fact that such programs must be mutually beneficial, developing national institutions should be rleatively stable and flexible. Another consideration is insititutional willingness to shift (or maintain) personnel on collaborative assignments; and of course the availability of high quality researchers and extension specialists from both sides is needed to spearhead the programs. Thus, a brief review of country policy vis-a-vis collaborative efforts in the agricultural sector, potential ICP collaborative institutions, and their stability, flexibility and resources (especially human) is in order.

Countries Visited and Their Major ICP Institutions

Guatemala. Guatemala has only a few trained personnel in ICP, and this greatly limits counterpart cooperation. Also, technical support is low, and facilities and supplies are very limited. The AID/Guatemala Mission is small and most ICP work should be coordinated through ROCAP and CATIE. Only one institution was thought potentially suitable for an ICP Title XII program: ICTA.

Instituto de Ciencias y Technologia Agricolas (ICTA)

ICTA is a public institution with the responsibility to generate and promote the use of science and technology in the agricultural sector. It is in charge of investigating ways of reducing production constraints in the agricultural sector. It is also charged with producing materials and methods to increase agricultural productivity. It also should advance technology utilization and help develop the rural regions of Guatemala (ICTA 1976).

ICTA was inaugurated in 1973 as an autonomous organization within the agricultural sector of the government. Its programs are designed in collaboration with the economic and planning sections of the government, with the agricultural services general directorate, the national agrarian development bank, and the national institute of agricultural commercialization. Organograms of the Guatemala Governmental Agricultural Sector (Fig. 4) and ICTA (Fig. 5) are presented.

ICTA has been in existence for seven years, hardly enough time to establish its stability. It is a semi-autonomous institution within the government, but governmental policies in some ways influence prioritization of commodities and approaches to problem solving. Its funding sources are the government of Guatemala with some additional money for specific programs from ROCAP and other bilateral agreements.

ICTA seems to be organized in such a way that concentrated efforts focus on certain commodities. For instance, the sorghum program, headed by Dr. Plant, has focused on major constraints, including insects (e.g. the sorghum midge causing 15-20% losses at a national level) and has attempted a thorough understanding of the constraints from which logical controls result (e.g. sorghum cultivar AF-28 from Argentina has good resistance to the sorghum midge). The flow of information from research to the small farm setting has many good points, among them feedback mechanisms, but with several million small farmers, it seems an almost impossible task to spread the word through the ICTA system (Table 14). There is a real problem in technology delivery.

Fig. 4.

ORGANIGRAMA DEL SECTOR PUBLICO AGRICOLA

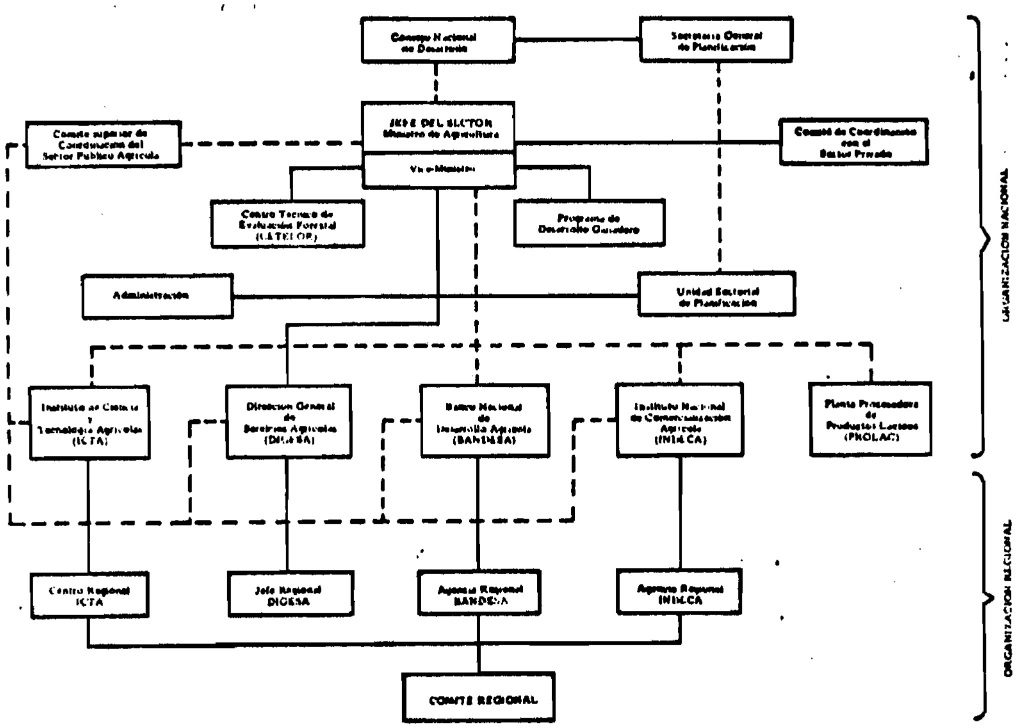
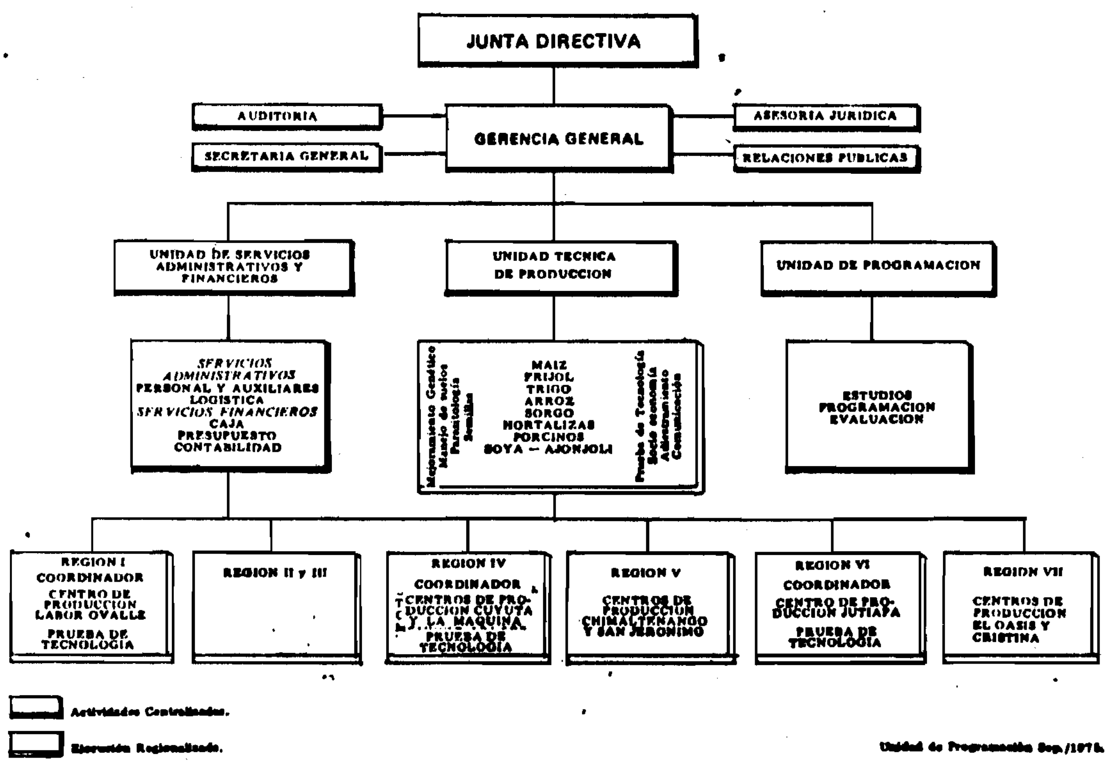


Fig. 5.

ORGANIGRAMA ICTA



Unidad de Programación Sep./1978.

ICTA has eight experiment stations throughout Guatemala. These assist in research and as bases for technology transfer.

In short, the small farm plant protection problems in Guatemala are many, and Guatemala could benefit from a cooperative program. ICTA lacks sufficient plant protection personnel, its facilities are inadequate and equipment minimal. Experiment stations and a good extension approach would add greatly to any collaborative effort. Political instability makes any collaborative effort more difficult.

Costa Rica. The team spent most of its allotted time within Costa Rica at CATIE, and as such saw very little in the way of national institutions. We did, however, reserve one afternoon to visit with the Faculty of Agriculture, University of Costa Rica.

University of Costa Rica at San Jose (UCR). This university has many cooperative programs underway with CATIE staff and some university staff teach and carry out research at CATIE. This inter-institutional cooperation enhances both UCR and CATIE. Together CATIE and UCR have a strong training program in agriculture at the postgraduate level.

The University of Costa Rica (UCR), College of Agricultural Sciences and Natural Resources is headed by an enthusiastic dean, Arias, who appears to support and encourage cooperative research in the general area of crop protection. Plant Pathology and Nematology facilities including greenhouse and laboratory equipment are quite adequate to carry out responsive research. Facilities and staff in the other crop protection areas of Entomology and Weed Science were not visited though they are known to be less adequate. A well equipped and adequately staffed seed lab, headed by Dr. Ron Echandi, compares very favorably with many of the better seed labs in U. S. institutions.

Small farmers are, relatively speaking, well off in Costa Rica. Delivery systems used by the Ministry of Agriculture and Livestock (MAG) are inadequate, but more money is being legislated for use in improving the delivery system at the national level. UCR seems an appropriate institution to address itself with the research and training aspect of ICP, but not with the extension aspects. Any ICP Title XII program initiated in Costa Rica should include personnel at UCR, MAG and CATIE. The research staff is fairly thin and a large program could seriously cut into the human resource availability at UCR and MAG. UCR is one of the better universities in Central America.

Since Costa Rica is a stable country, many bilateral programs are in progress, all of these drawing on the limited human resources of that country's institutions.

Colombia. Colombia is a vast and varied country with a considerable governmental emphasis in the agricultural sector. The prime institution for agricultural research and the only institution we visited that could be a Title XII ICP cooperator is the Instituto Colombiano Agropecuario (ICA). Its organization is diagrammed in Figure 6.

AID/Colombia was in the midst of leaving Colombia during our visit. AID Rural Development Officer, Dr. David Schaer, has set up a mechanism with Ministry of Agriculture and especially within the Department of National Planning, formulating a Memorandum of Intention whereby funds accumulated through double-step loans from AID would be made available as a 25% cover for Title XII work in Colombia. The major institutions involved would be the Department of National Planning and ICA. This is a major step towards generating in-country funding for such a program. Dr. Schaer is to be commended for his vision and execution of this document, along with others that contributed greatly to its content and completion. A copy of this document is attached to the report as Appendix H.

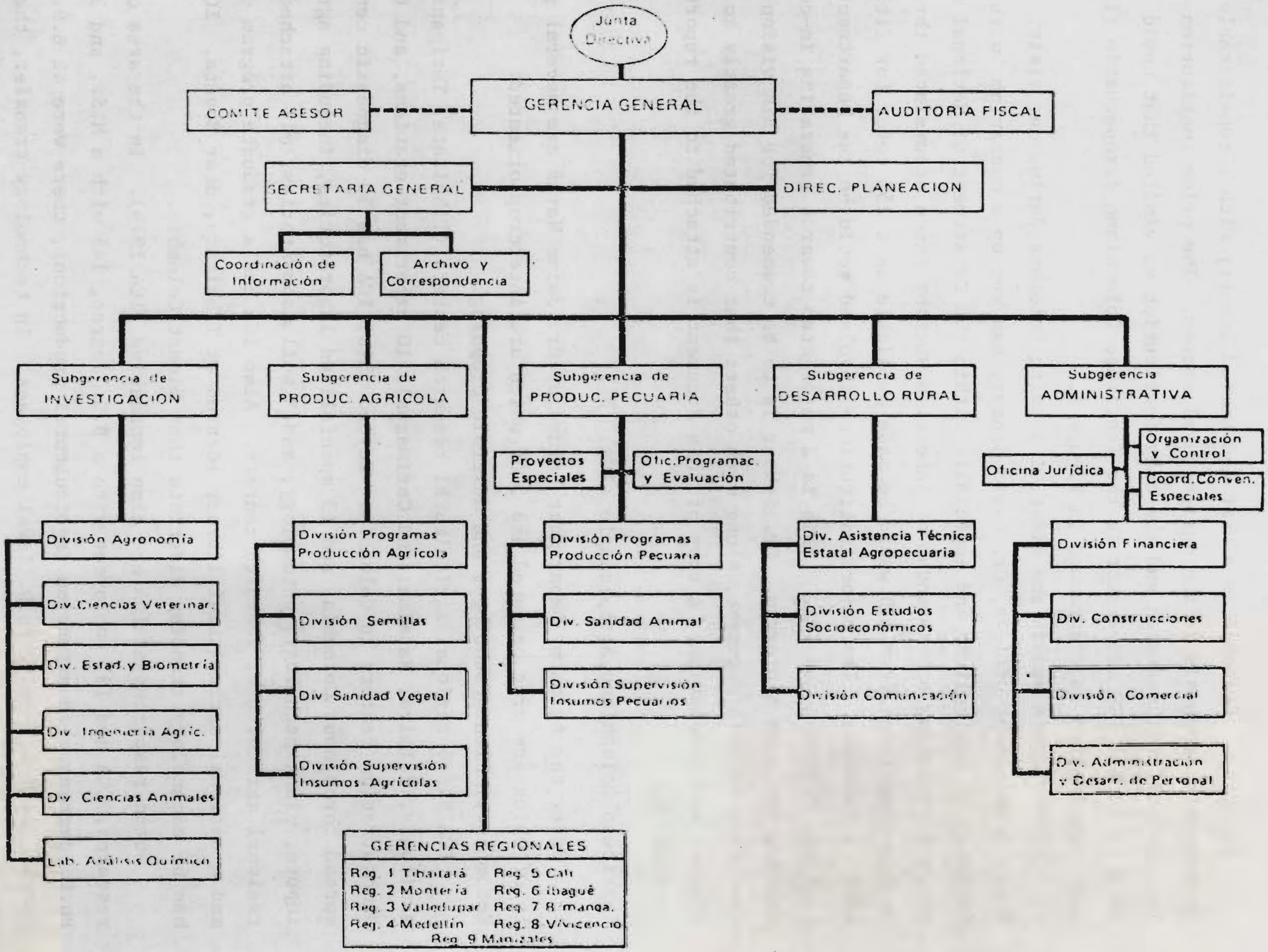
Instituto Colombiano Agropecuario (ICA)

Under the Agronomy Department headed by Dr. Jaime Navas are several programs, 16 of which are crop oriented and 3 of which are intercrop oriented: Entomology, Plant Pathology, and Multiple Cropping.

ICA has 6 regional agricultural research centers (Tibaitata, Turipana, Matilonia, Palmira, Nataima, and Carimagua), 10 experiment stations, and 6 demonstration centers in Colombia. Beyond this, ICA has 30 diagnostic centers spread throughout Colombia, and 13 specialized laboratories, including agricultural inputs, plant pathology, entomology, and 3 soil laboratories, all attached to regional agricultural research centers. Also ICA has a graduate program of studies and a national agricultural library located at Tibaitata, near Bogota. ICA also has 66 technology transfer districts that bisect Colombia.

Human resources at ICA are also impressive (ICA 1979). In the area of research, ICA had 137 employees with a B.S. degree, 145 with a M.S., and 39 with Ph.D. degrees. In extension (agricultural production), there were 42 B.S. degree people, 24 M.S., and 2 Ph.D. level employees. In technology transfer, there were 222 B.S. employees and 17 M.S. employees. These figures were current as of 1979. The number of employees in each of the above categories has dropped substantially between 1974 and 1979, overall a drop from 1,346 to 1,100 employees. The major cause of this decline is poor salaries throughout the government agricultural sector.

Figura 6



Organización

The team, which only visited two regional centers, was very impressed with the ICA plant protection personnel visit. It also was aware of the need for improvements in technology transfer, especially to small farmers.

Colombia, and consequently ICA, has much stronger and more directed programs in plant pathology than in other ICP disciplines, including entomology. Due to the fact that the AID/Colombia mission is leaving Colombia, thus making for more difficult liaison with the Colombian government and ICA, we suggest limited involvement in Colombia. The involvement should be limited to research in the areas of virus etiology and epidemiology, areas that already have active Ph.D. level professionals involved. This seems ideal for minimal involvement activities and could result in increased productivity on farms, especially small farms. Such limited projects might concentrate on viruses of corn, beans (and related legumes), and potatoes, three important food crops in Colombia and throughout Latin America. An economist should be brought into such projects, either from U.S. universities or from Colombia.

Peru. Peru is also a very diverse country that has had in the past a strong commitment to agriculture. With the agrarian land reform and the military government of the past decade the country has experienced a steady deterioration of this commitment. Currently Peru's agricultural sector is in dire straights.

Recent elections will likely reverse this trend and begin to strengthen the agricultural sector in Peru. It is this fact that gives us hope for a successful and fruitful Title XII ICP program in Peru. Peru has two organizations that can be combined for the leading institutions for collaborative ICP Title XII program: INIA and UNA. The stability, flexibility, human resources, facilities, and equipment, and current programs related to ICP are outlined below.

Instituto Nacional de Investigacion Agraria (INIA)

INIA was created in 1978 by the Agricultural Sector Law No. 2232 as an autonomus and decentralized public entity and started its operations early in 1979. The following are the objectives of the INIA:

1) To develop scientific and technological information in order to attain a rational exploitation, utilization and conservation of Agrarian Sector resources.
2) To generate appropriate technologies to facilitate sustained growth in agricultural production.
3) To develop appropriate agro-industry technologies oriented toward

better utilization, conservation and transformation of agricultural products.

4) To contribute to the improvement of the nutritional levels and patterns of the population.

As shown by its organization chart (fig. 7), INIA is administered by an Executive Council headed by a President who is appointed by the Minister of Agriculture and Food, and composed of four Director Generals corresponding to the Ministry of Agriculture and Food: General Directorates of Agriculture and Livestock, Water and Soil, Forestry and Fauna Research Centers (FFRC), and Marketing.

INIA has four regional research centers and three forest and fauna research centers. The former (fig. 8 is a diagram of the organizational structure), through a network of fourteen experimental stations, carry out research programs with priorities oriented to the solution of technological problems in crop development and livestock. Also through the experimental stations, adoption and transfer of appropriate technologies, including the development of improved seeds, are accomplished. Similarly, the FFRC's presently use six Experimental Stations, four of which are located in the sierra and two in the jungle. Establishment of additional experimental stations on the coast is under review. INIA is also responsible for the Agro-Industrial Research Institute. Its objective is to execute, on a national level, technological research in food technology related to better utilization, conservation, and transformation of agrarian products.

INIA's budget for 1979 shows receipts of US$3.8 million derived from three sources: (1) the public treasure, (2) operational income, and (3) international debt (see budget below).

Fig. 7

INSTITUTO NACIONAL DE INVESTIGACION AGRARIA

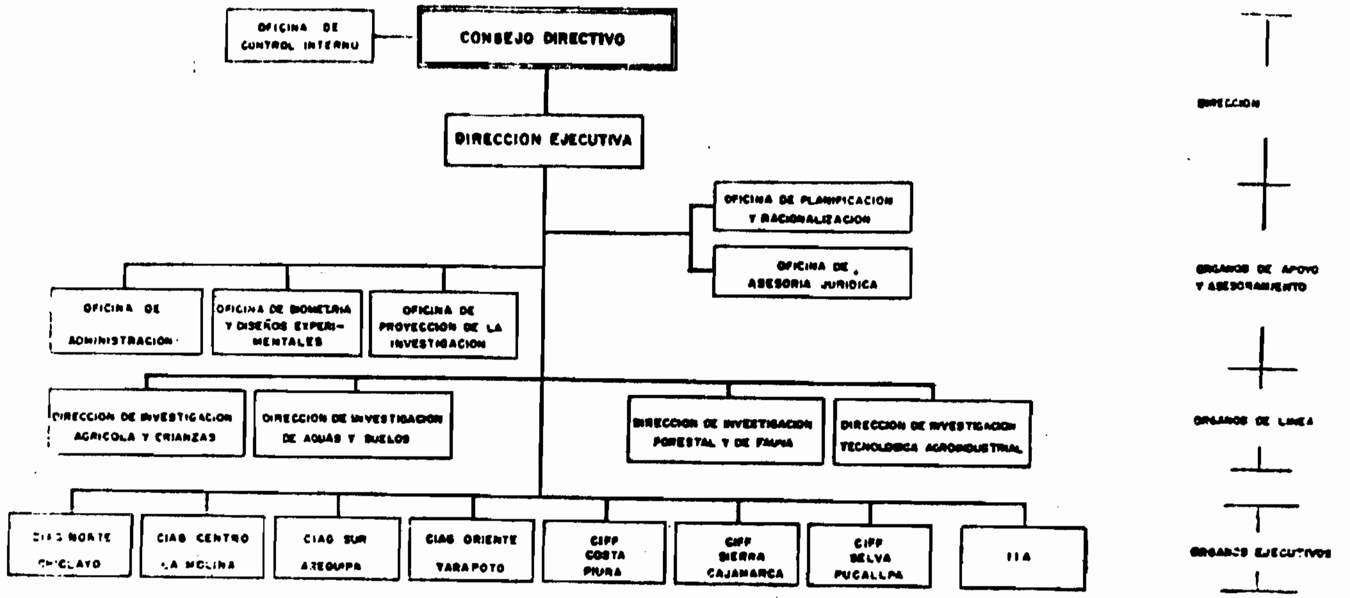
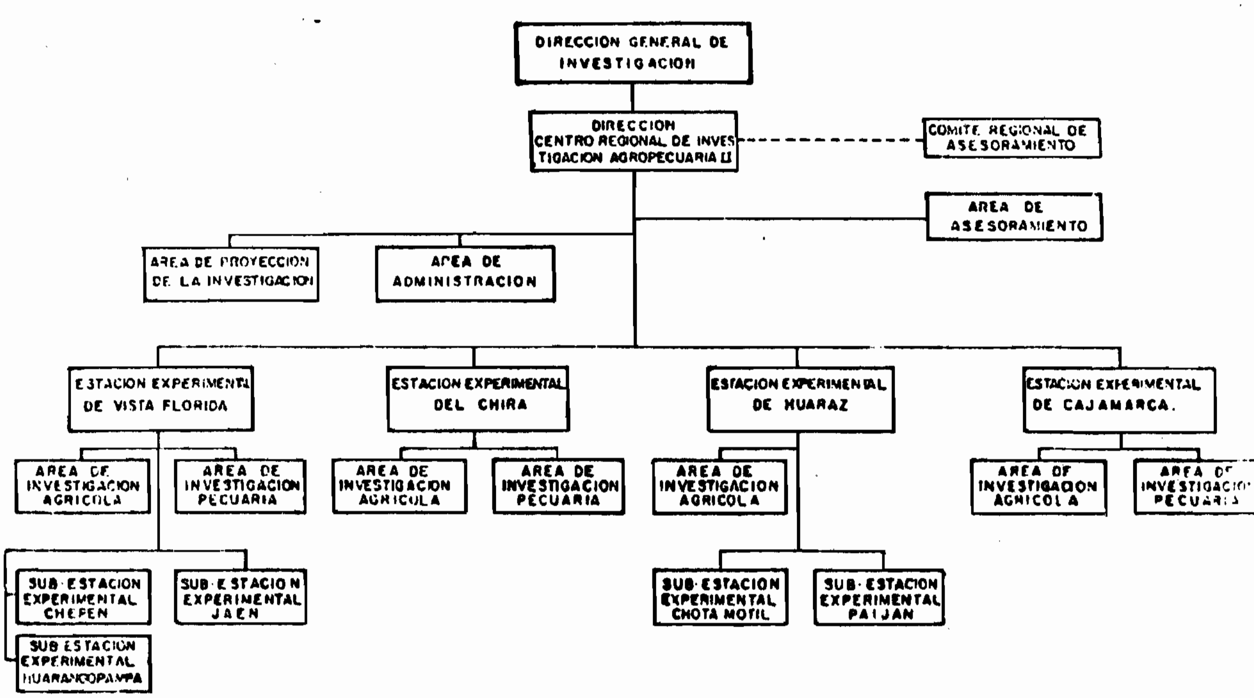


Fig. 8

CENTRO REGIONAL DE INVESTIGACION AGROPECUARIA DEL NORTE-II CHICLAYO



Instituto Nacional de Investigacion Agraria
1979 budget in US$ (x1000)

	Treasury	Operational Income	Intrnl. Debt	Total	% of Total
Wages and Salaries	1897	99	--	1996	52.1
Goods	69	321	--	390	10.2
Services	79	164	--	243	6.3
Studies	171	52	46	269	7.0
Works	510	87	80	677	17.7
Social Security Transfers	102	38	--	140	3.7
Equipment and Machinery	94	19	--	113	3.0
TOTAL	2922	780	126	3829	
	76%	20%	4%	100%	

A toal of $2.9 million was transferred from MAF to INIA in 1979; a good part of this (65%) is devoted to salaries. These funds are not subject to great yearly fluctuations.

Recently, a law was passed giving INIA the mandate to incorporate extension activities of the Ministry of Agriculture and Foods (MAF) into its organization (Appendix F). This now places extension and research activities under one institution of the public agricultural sector.

Although INIA was meant to be an autonomus institution, priorities eminate through policy decisions by MAF and INIA's Executive Council. These priorities change in accordance with MAF national directives. These tend to be political. Therefore, stability, although not tested in such a young institution, seems rather shaky.

INIA has 668 persons in the crop-oriented portion of its organization, of which 302 (46%) are in administration, 109 are technicians, 23 hold B.S. degrees, 195 have Ing. Agron. degrees, 33 have MS. degrees, and only 6 hold Ph.D's (INIA 1979). This does not count the new extension arm that will be under INIA direction. This shows clearly the concentration of administrators and the lack of highly trained (M.S. and Ph.D. level) personnel in the organization, due largely to attrition caused by low salaries and poor working conditions. This latter point shows quite clearly in a table depicting decision-levels on type of research to be conducted (INIA 1979, p. 162). Nearly half of the decisions are made by the station director and others by some superior authority, leaving the researcher with but a small part of the decisions regarding the type of research he will pursue and how he will pursue it.

In theory, moneys for INIA research go to individual experiment stations, but the use of these funds still needs approval from the central INIA office in Lima. Management of outside contracts has been rather rigid and inflexible because of rider clauses attached to the use of funds.

INIA has several diagnostic centers. At La Molina there is a center in Plant Pathology and Nematology, and also a small entomological museum that is not adequately equipped and staffed. Also, newly attached to INIA - La Molina is an independent organization, the Introduction and Rearing Center for Beneficial Insects (CICIU) (INIA 1980) that has a very small museum and library. INIA - Porvenir at Tarapoto has a plant pathology diagnostic center and a small, inadequately equipped insect museum.

Laboratories at INIA - La Molina are small, poorly equipped and associated with major crops, although a large number of soil samples for nematode analysis are processed each year. At INIA - Vista Florida were similar conditions, but the soils and nematology laboratories were in better shape.

The field station situation was much better; small field stations covered all areas of Peru.

There are programs currently underway in INIA that relate to ICP. One, a soybean insect pest management program is underway in the high selva with a USAID/Peru and INTSOY contract. Bean breeding and evaluation for resistance to various insects and viruses is also in progress with CIAT. At CICIU, biological control and release of beneficial arthropods in various crops is in progress (Table 15) and these insects are for sale. Also there is supervised control program of potato insect pests underway in the central coast.

Universidad Nacional Agraria (UNA)

UNA has been in existance for 78 years. It is governed by faculty and administrator as a senate body that formulates general policies of the university. The senate body established goal priorities with feedback at departmental level. Funding is by several means, one of which is the Government of Peru. It allocated UNA $2.9 million in 1979. An additional $875,000 was added to UNA through its own investments in 1979, through sales of products and services. Further monies came from contracts for specific research areas. One such example is in the area of

Table 15. List of beneficial insects for sale by CICIU, INIA.

"RESOLUNION MINISTERIAL No 0930-77-AL.-Lima, 13 de Satiembre de 1977. - CONSIDERANDO:. -- Que por Resolución Ministerial No 640-76-AL, de 01 de Satiembre de 1976, se aprobó la venta de controladores biológicos, por la Dirección General de Producción estableciéndose la tarifa correspondiente; -- Que el Articulo 3º de la citada Resolución, faculta a la Dirección General de Producción para proponer la actualización de la tarifa de venta, cuando las variaciones de los costos de drianza no colección lo justifiquen, a ligual mente para proponer el precio de venta para otros especies no consideradas en dicha Resolucion, -- Que el Informe Técnico del Centro de Introducción Y Cría de Insectos Utilas (CICIU) de la Direccion General de Producción, sustenta la modificación de los costos de producción en Laboratorio o de colección en campo, sesegún los casos, así como la necesidad de incluir otros controladores biológicos de reciente adaptación al país y otros servicios no contemplados en la mensionada Resolución Ministerial; y con la visación del Director General de Administración: SE RESUELVE: - Artículo 1º. Aprobar la modificación de la tarifa de venta de controladores biológicos establecida por Resolución Ministerial No 640-76-AL, de 01 de Setiembre de 1976, la que en adelante y hasta nueva disposición, será la siguiente:

Trichogramma spp. . . . . .S/.	1,500.00	el millon
Aphytis spp.	5,500.00	una colonia
Metaphycus helvolus o *Coccophagus rusti*	1,000.00	el millar
Scymnus (*Nephus*) spp. o *Hyperapis* spp.	5,500.00	una colonia
Anagyrus spp. o *Pauridia peregrina*	1,000.00	el millar
Novius cardinalis	5,500.00	una colonia
Amitus spinifera	5,500.00	una colonia
Aphidius smithi	5,500.00	una colonia

Artículo 2º - Aprobar asimismo, el precio de venta de las siguientes especies no considera das en la tarifa autorizada por Resolución Ministerial No 640-76-AL:

Huevos da *Sitotroga cerealella* cantidad necesaria para producir un millon de Trichogramma 24 grs. = 240 pulgads cuadradas de huevos pegados en cartulina) S/.	1,500.00	por 24 grs. (o 240 pulg. cuadradas).
Leptomastidea spp. o *Aenasius massi*, o *Grandoriella lamasi*	1,100.00	el millar
Aphelinus mali	5,500.00	una colonia
Cales noacki	5,500.00	una colonia
Rhizobius pulchelus	5,500.00	una colonia
Gitona brasiliensis	5,500.00	una colonia

Artículo 3º - Los recursos que se obtengan por aplicación de lo dispuesto por la presente Resolución, constituyen Fuente de Financiamiento Ingresos Propios del Presupuesto del Programa-Producción, del Pliego-Ministerio de Alimentación. Regístrese y comuníquese. -- (FDO) GENERAL DE DIVISION EP. RAFAEL HOYOS RUBIO-MINISTRO DE ALIMENTACION" . . . .

small ruminants. INIA has a Title XII contract with the University of California at Davis, but contracts much of the research to UNA.

Teaching objectives are decided at the level of academic programs and are kept relavant by feedback through the academic senate.

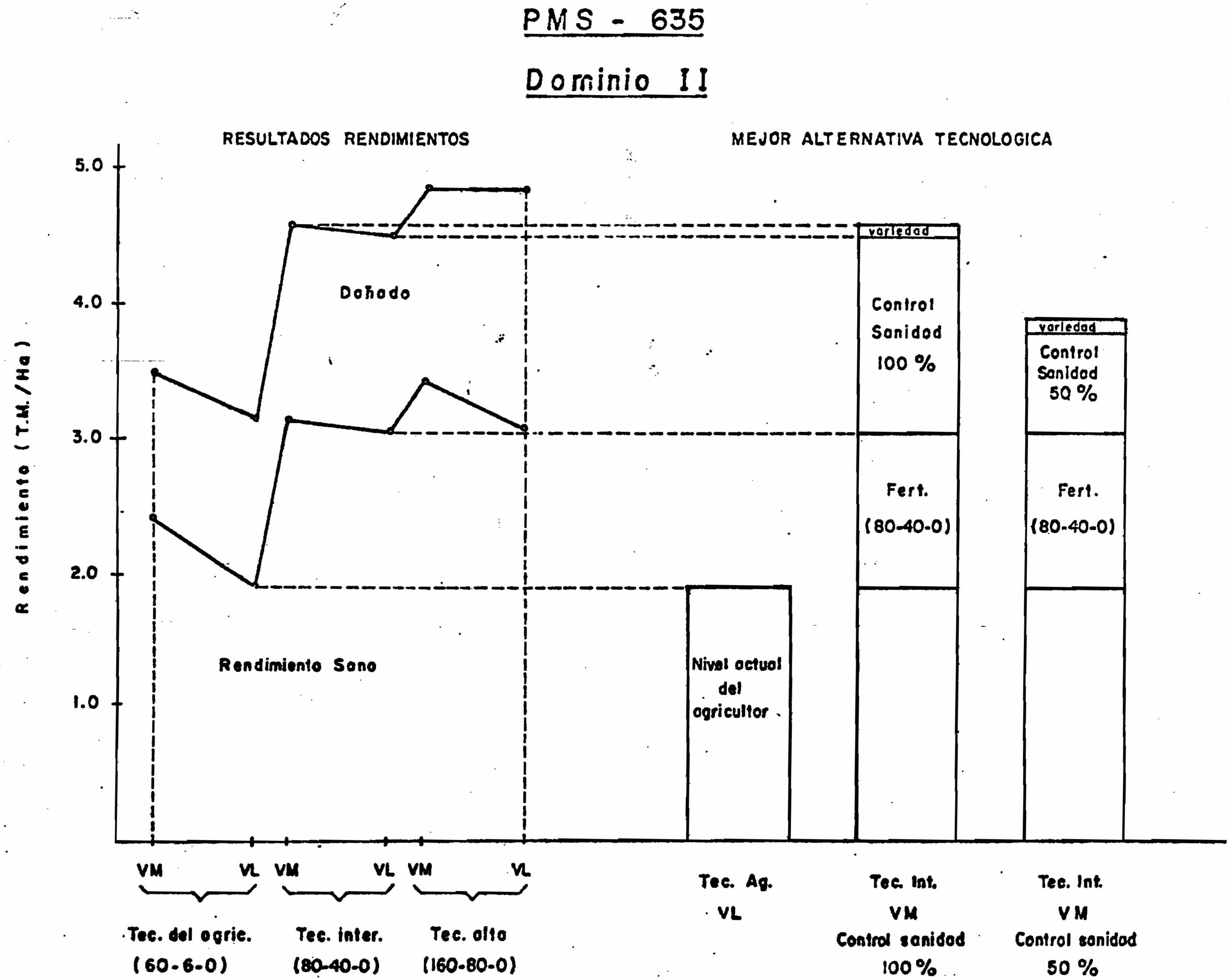
Extension is not a function of UNA.

Monitary flow takes on three forms within UNA: (1) official budgetary system, that is government money, that is inflexible; all monies each year must be allocated; (2) special accounts system, used for small, uncomplicated contracts; these funds are moderately flexible, service is free; money can be saved from one year to the next; and (3) the National Development Foundation Fund, a lateral institution to UNA that funnels funds autonomously; it is used for larger, complex contracts; there is a service charge but fund and fund use is very flexible.

UNA has several national programs; the national corn program is one example. These programs help direct the flow of research, extension, and services on a commodity basis. (INIA has such a program at a regional level in beans at Vista Florida in cooperation with the Universidad Nacional Pedro Ruiz Gallo at Lambayeque.) The National Corn Program under UNA has prospered in its 25 years of existence and has done much to supply certified seed, establish production practices, and establish pest control strategies for corn grown in various parts of Peru. Figure 10 illustrates an example of the factor analysis the corn program has been attempting to help improve corn quality and quantity.

Facilities and equipment are adequate, however, much of the equipment in plant pathology is of models where parts are difficult to obtain and as such was not in operative condition during our visit. BID has just given UNA a large loan for building more facilities to replace facilities lost in the 1974 earthquake. The library is moderately good and is called the National Agrarian Library. Diagnostic centers are few but of good quality: the entomology museum is fair and a potential exists for increasing its usefulness on a national and regional (Andean Pact countries) basis; the curator is interested in the identification and taxonomy of two very important groups of insects (thrips and aphids). Plant pathology has an adequate diagnostic facility that includes a small specimen museum. Weed science has access to a relatively good and active herbarium and good taxonomic botanists. Nothing at the present exists for diagnostic services in nematology.

Figure 13



PMS - 635
Dominio II
RESULTADOS RENDIMIENTOS
MEJOR ALTERNATIVA TECNOLOGICA
Rendimiento (T.M./Ha)
5.0
4.0
3.0
2.0
1.0
Dañado
Rendimiento Sano
variedad
Control Sanidad 100 %
Fert. (80-40-0)
variedad
Control Sanidad 50 %
Fert. (80-40-0)
Nivel actual del agricultor
VM
VL
VM
VL
VM
VL
Tec. del agric. (60-6-0)
Tec. inter. (80-40-0)
Tec. alta (160-80-0)
Tec. Ag. VL
Tec. Int. VM Control sanidad 100 %
Tec. Int. VM Control sanidad 50 %

International and Regional Agricultural Research Centers

The team visited two international agricultural research centers (CIAT and CIP) and one regional center (CATIE). We unfortunately had no opportunity to visit CIMMYT. The three international research centers in Latin America (CIMMYT, CIAT, CIP) work with the major crops of the region: corn, beans, wheat, barley, potatoes, cassava. Most of their efforts have been in breeding plants for higher yield or more stable yield under adverse conditions, including pests.

CATIE had an emphasis in cropping systems and, as such, was more involved in the transfer of complex technology.

All these centers had many things in common: they were well staffed with highly competent researchers, the facilities were very good and well equipped; the administrative unit had a solid understanding of the directions of the institutions and was well respected by the staff.

All of these institutions felt they could and should play a role in Title XII activities, especially in the areas of training and breeding for improved plant genotypes. CATIE was interested in providing diagnoses of pest problems at a regional level.

The team was convinced that any ICP Title XII programs in Latin America should be linked with programs at the international and regional agricultural research centers where such linkage would prove mutually beneficial.

EVALUATION OF POTENTIAL SITES FOR ICP TITLE XII PROGRAMS

The evaluation of potential country sites for Title XII ICP programs must take into consideration several factors. Initially, the question of political stability must surface. In that respect, Guatemala is unstable and probably should be avoided. All other countries we visited appeared politically stable. The second question involves need. Does the potential site have a strong need for collaborative research in ICP? Costa Rica has a fairly prosperous population with little visible poverty at the small farm level. However, the University of Costa Rica has a strong interest in ICP programs and is willing to collaborate under a Title XII program with U. S. universities and CATIE, its regional center. We did not meet with Ministry personnel in Costa Rica. Colombia and Peru demonstrate strong needs for such a program.

Another factor that comes into play in the selection of country sites is counterpart scientists. Does the country have well-trained scientists in ICP and are they willing to cooperate? Certainly Colombia and Peru have excellent counterpart personnel, more in the area of plant pathology in Colombia; more in entomology in Peru. But both countries have adequately trained personnel in all areas of IPC. Costa Rica fits this criterion too.

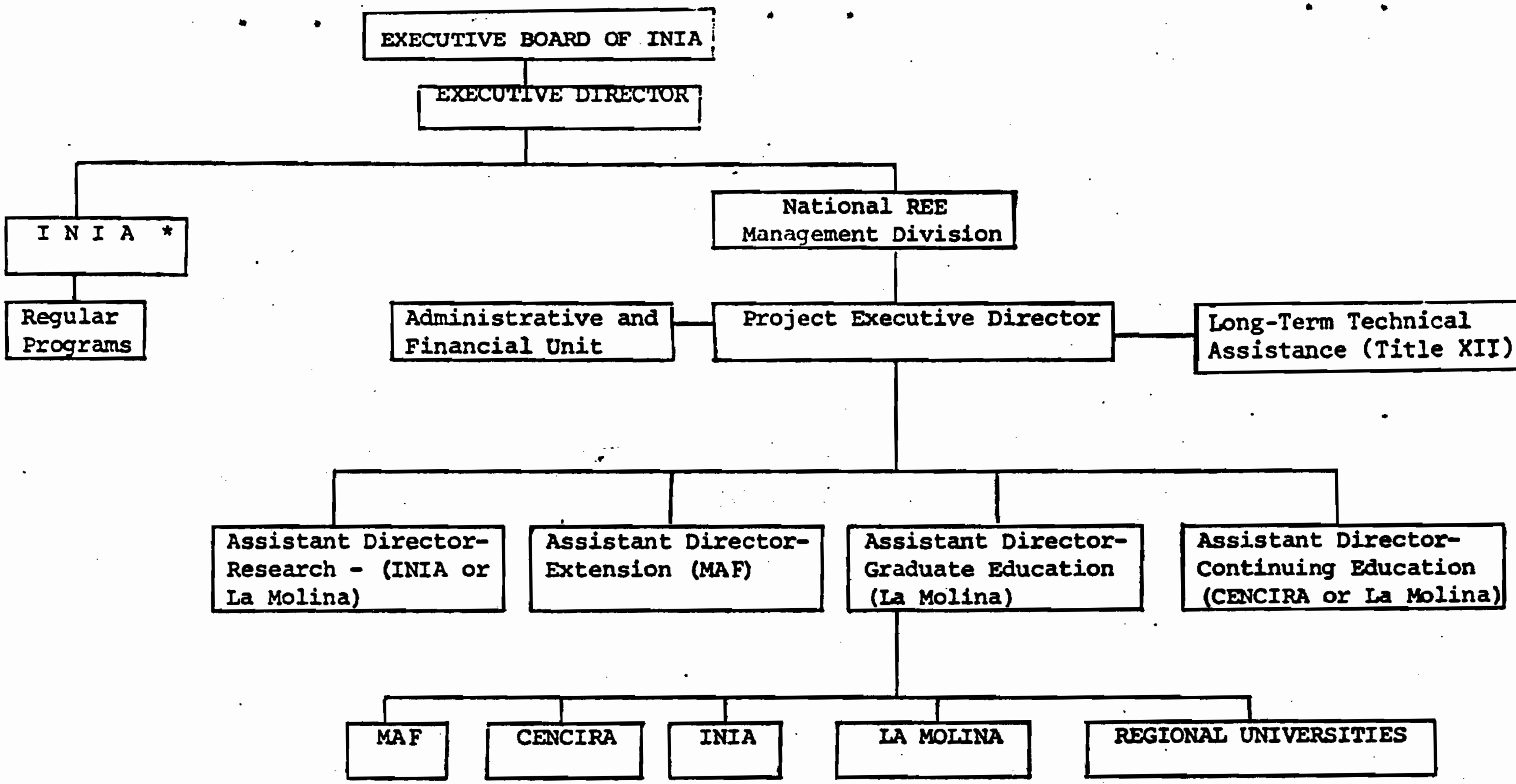
The two main countries, then, that need to be evaluated are Colombia and Peru. With the AID mission pulling out of Colombia, the case for a solid, large program is less secure. Without liaison between the government and the Title XII program, difficulties in bureaucratic tie-ups are even more frustrating and time consuming. The concept of using Colombia as a secondary site, a site for a limited, directed research program in virus etiology and epidemiology of the major food crops seems appropriate. With funds already set aside for part of such a program (Appendix H), much could be done in the collaborative mode to further the research in crop-limiting virus diseases. There are well trained virologists and entomologists with which participating U. S. universities could work.

Peru is another matter. Its needs for turning around the agricultural sector are urgent and obvious. The AID mission is getting stronger and is under good leadership. The government has just undergone elections for president and the newly elected president has the philosophy to build up the agrarian sector, education, and he has worked hard to open the high selva to agriculture.

Title XII has just sponsored a baseline study of Peru that has pointed out the areas where improvement in the public agricultural sector should occur: research, education, extension. Since that time, extension has been united with research. Education has been given a BID loan for facility improvement, and AID, under John O'Donnell, Loren Schulze, and others, has concentrated on improving the agricultural sector. Through a Peru project paper (number 527-0192) entitled "Agricultural Research, Extension, and Education (AID/LAC/P-042)" AID has laid the foundation to upgrade the public salaries, provide for and supply regional research centers and national research support, provide for and supply national production programs and regional service laboratories, help finance a broad agricultural education program, and provide for and support a national research, extension and education management unit (Fig. 11)

The government of Peru and AID are focusing on the selva alta for increased production. AID, in another project paper (number 527-0163) entitled "Peru - Development of Subtropical Lands (AID-DLC/P-2278)" has loaned the government of Peru $19 million for opening up and providing infrastructure to the high jungle zone. Included in this loan are the following components: roads, road maintenance,

Figure 11



*Those programs not included in REE system.

agricultural credits, land clearing, farm machinery and services, marketing facilities and services, land surveying and titling activities, extension services, resource studies, and technical assistance. Together, these loan/grant papers pave the way for a strong and vital agricultural program in the high selva of Peru, especially around the Tarapoto region. One drawback to the Tarapoto region is the lack of a substantial well trained ICP oriented staff for collaborative research. Other areas of Peru visited had more staff and facilities than did the Tarapoto region. Nowhere in these documents is there a clean committment to crop protection as a vital component. By attaching such a component through a Title XII CRSP on ICP, the AID mission programs in Peru would be strengthened and, at the same time, by having this enormous amount of infrastructure and activity in the public agricultural sector, such an ICP program would have a framework around which to work and a support system not possible under normal circumstances.

POTENTIAL LINKAGES WITH ICP TITLE XII PROGRAMS: CONCLUSIONS

Of the countries visited by the Latin American site team, Peru would provide the most logical linkage for an in-depth ICP Title XII program. The program, we feel, should link with priority development regions of the country, such as the Tarapoto area in the selva alta, and should embrace all aspects of a pest management program. The Tarapoto area is a typical humid, high, tropical environment and the information gathered from a study in that area, we believe, will be relative and easily transferred to other areas of the American humid tropics and subtropics. A study involving sampling procedures, establishing economic thresholds, deploying supervised control experts (scouts), developing workable delivery systems and decision-making processes all across the range of pest problems (weeds, insects, pathogens, vertebrates, nematodes) and tuned to the cropping pattern of the area is needed. This, in itself, is a research project -- how can the package be put together and made to function, and how can such a package be transferred to other areas? Both the smaller research area, the area of interactions of pests within and among crops in a cropping system, is at the heart of the program.

Because of AID's interest in developing the selva alta (AID/Peru 1978) and in developing the public agricultural sector through strengthening the research, extension and education components (AID/Peru 1980, REE), it seems logical to link with these projects.

Colombia, we feel, is another country with potential for ICP Title XII linkages. The most likely institution for such linkage is ICA (with the National Planning Department, Appendix H). Because the AID mission is leaving Colombia, we believe a limited involvement is in order, one that focuses on the strengths of ICA and that addresses problems that continue to pose serious threats to crop production in tropical Latin America. Plant pathogenic virus and mycoplasmas fit the above criteria. We strongly urge a linkage with ICA to solve virus epidemiology problems in basic food crops. Once a project of this nature took hold, we feel it could easily move to neighboring countries such as Costa Rica.

Identification services are scarce in the developing world. Many problems could be solved more rapidly and easily if the causative agent were known. This, of course, would open the literature and allow one to find possible control measures. We feel it highly desirable that CATIE, perhaps in conjunction with the University of Costa Rica, develop the capacity to make identifications of important pest species, especially in the areas of entomology, virology, and nematology. A similar program should be funded for INIA and UNA, La Molina. These same institutions could serve as postgraduate training centers in ICP, along with CIAT, CIP and CIMMYT.

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APPENDIX A

INSTITUTIONS AND PERSONS CONTACTED

I. GUATEMALA

A. Instituto de Ciencia y Technologia Agrícolas (ICTA) (5a Avenida 12-31, Zona 9, Edificio El Cortez, Guatemala, C.A.)

Dr. Freddy Alonzo, entomologist, Ph.D. from Michigan State University
Dr. Albert Plant, sorghum coordinator (Ph.D. in soils at Texas A & M Univ.). 12 years in Guatemala; was with American Potash Institute
Ing. Hugo Cordova, corn breeder; production specialist assigned to ICTA by CIMMYT and AID
Ing. Jorge Pineda, sub-gerente general de ICTA
Ing. Hugo Orzco, ICTA at Chimaltanango; bean breeder from CIAT; a Colombian

B. Regional Office for Central American Projects (ROCAP/AID)(8a Calle 7-86, Zona 9, Guatemala, C.A.)

Mr. Donald R. Fiester, Agricultural Coordinator will move to Washington, DC as Director DS/AGR/AID
Dr. Eduardo E. Trujillo, CICP/ICR Depart for CA. University of Hawaii, plant pathologist on assignment with ROCAP
Mr. Robert Hechtman, Acting Assistant Director

C. USAID/Guatemala

Mr. James Bleidner, Rural Development Officer
Mr. Clem Webber, in charge of ICTA projects

II. COSTA RICA

A. Centro Agronómico Tropical de Investigación y Ensenañza (CATIE) (Turrialba, Costa Rica)

Dr. Eduardo Locatelli, Deputy Director for Training and Technical Cooperation. Formerly weed scientist on AID/Oregon State Project. Originally from Uruguay.
Dr. R. Moreno, plant pathologist and cropping systems as related to diseases. Includes work on mulches. Originally from Chile.
Dr. Joe Saunders, entomologist, working on identification of insect pests of crops and with Myron Shenk on effect of mulches vs. tillage on insects of corn.
Myron Shenk, weed scientist on AID/Oregon State Project
Dr. Luis A. Navarro, agricultural economist. Originally from Chile.
Dr. Arnold L. Erickson, Administration
Dr. Andrew B. S. King, entomologist
Phil Shannon, entomologist

B. College of Agriculture, University of Costa Rica, San José (Ciudad Universitaria Rodrigo Facio)

Ing. Jorge M. Delagado M., Dean
Dr. Jorge Fonseca, Head, Agricultural Economics
Dr. Gilbert Fuentes, Entomologist, Ing. Agr.
Dr. Luis Carlos Gonzales, plant pathologist
Ing. Enrique Orologo, entomologist, with Entomology Museum

C. USAID/Costa Rica

Robert N. Mowbray, Rural Development Officer, going to Jamaica in June as RDO.

D. Church group visiting CATIE

Ralph van Dixhorn, many years in Ecuador with a church mission and later with AID. Now looking at a position in Barquisimeto, Venezuela with church groups to set up agricultural communications center for small farmers. P.O. Box 1004, West Bend, WI 53095.

III. COLOMBIA

A. Departamento Nacional de Planeacion (Calle 22, 13-19, Piso 9, Bogotá)

Dr. Nohora Bateman, Head, Technical Cooperation Division
Dr. Alicia Romero M., Agricultural Planning Officer

B. Instituto Colombiano Agropecuario (ICA) (Calle 37, 8-43, Piso 8, Edeficio Colgas, Apartado Aereo 7984, Bogotá)

Dr. Manual Alvarez R., Subdirector, in charge of research (did not meet him).

1. Tibaitatá Regional Experiment Center (Apartado Aéreo 151123, Bogotá)

Dr. Jaime Navas A., Head, Agronomy Division
Dr. Jesus Arias F., Leader, multiple cropping (Ph.D. Iowa State Univ.)
Ing. Luis A. Valbuena T., Leader, multiple cropping in Bogotá Region
Dr. Carlos Rodriguez Amaya, Head, Agricultural Engineering Division (M.S. Univ. Ill., Ph.D. Colorado State Univ.)
Ing. Fabio Higuita, horticulture (M.S. Michigan State Univ.)
Dr. Ciro A. Villamizar Martinez, Leader, communications (Ph.D. Texas A & M Univ.)
Dr. Gilberto Vejarano M., communications
Dr. Lazaro Pasada, Leader, entomology
Dr. Ingeborg Zenner-Polanía, entomologist
Ing. Aristobulo Lopez, entomologist
Ing. Nhora Ruiz, curator of entomology collection
Dr. Pablo Buritica Cespedes, Leader, plant pathology; fungal diseases
Dr. Gerardo Martinez Lopez, virologist (Ph.D. Univ. of Ill., recent sabbatical at OARDC, Wooster, OH).
Ing. Luz Marina de Cujia, virologist
Ing. Concepción de Luque, virologist
Ing. Vincent Flores, Agricultural economics (M.S. Univ. Nebraska)

2. Palmira Regional Experiment Center (Apartado Aeréo 233, Palmira)

Dr. Ramiro de la Cruz, Regional Director of Research; Head, plant physiology; weed control programs (did not meet)
Ing. Gilberto Bastidas, Leader, legume program; legume breeder
Dr. Jorge I. Victoria, Leader, plant pathology; bacteriologist (M.S. Cornell Univ.; Ph.D. Univ. Wisconsin). Working on diseases of beans and soybeans.

Ing. Gustavo Granadas, virologist (receiving Ph.D., Univ. Wisconsin), (did not meet).
Ing. Olivero Cardereas, weed control in corn and soybean (did not meet).
Ing. Raul Vanla, weed control in legume crops (did not meet).
Ing. Francia de Agudelo, nematologist and virologist (M.S. at ICA, Tibaitatá).
Dr. Fernando Arboleda, corn breeder (M.S. and Ph.D., Univ. Nebraska).
Ing. Francisco Ocampa Rojas, national coordinator, cacao program. (M.S. at CATIE).
Ing. Fulvia Garcia R., Leader, entomology program. Biology and control of Scaphytopius fuligenosus, the vector of machismo disease of beans and soybeans (M.S. at ICA, Tibaitatá).
Ing. Bertha Alomia de Gutierrez, entomologist. Biological control and insect biology (M.S., Univ. Nacional de Colombia and ICA Tibaitatá, 1979).
Ing. Raul Varela, agronomist. Interested in obtaining overseas Ph.D. in Rhizobium-related research on legumes. ICA has made scholarship available to him.

C. Rohm and Haas Colombia, S.A. (Carrera 15, No. 87-86, Piso 20, Apartado Aéreo 90606, Bogotá)

Ing. Rodolfo Briceno Velasco, Director, department of agriculture (M.S. with Ken Buchholtz, Univ. Wisconsin).
Luis F. Sandoval C., Head, Department of Research and Development in Cali (Avenida 6a. A. Norte No. 24 N-56, Apartado Aereo 6664, Cali, Colombia). Cooperates with Dr. Leihner, CIAT, on cassava weed control.

D. USAID/Colombia (Calle 28, Carrera 10°, Torre A, Piso 14, Bogota)

Mr. Jerry Martin, Mission Director (did not meet).
Dr. David H. Schaer, Rural Development Officer. Trained as veternarian, will join AFR/DR in Washington, D.C. by July 1, 1980.

E. Centro Internacional de Agricultura Tropical (CIAT) (Apartado Aéreo 67-13, Cali, Valle, Colombia)

Dr. John L. Nickel, Director General (Ph.D. in Entomology, Univ. Calif., Berkeley).
Dr. Fernando Fernández, Coordinator, training and conferences; plant scientist.
Dr. Fritz Kramer, Coordinator, Communications Support Unit.
Mr. Fernando Mora, Head, Public Information Office
Dr. Douglas R. Laing, Physiologist, Associate Director General, Research (Ph.D. Iowa State Univ.; from Australia).
Dr. Aart van Schoonhoven, entomologist, coordinator, bean program (Ph.D. Kansas State Univ.; from Holland).
Dr. Jeremy Davis, bean breeder (Ph.D. Cambridge). Multiple cropping of corn and beans.
Dr. Francisco J. Morales, bean virologist.
Dr. Peter H. Graham, microbiologist, bean program (Ph.D. Perth); has worked with mulches in beans.

Dr. Silvio H. Orozco, bean breeder attached to ICTA, Guatemala (met him in Guatemala).
Dr. John H. Sanders, agricultural economist, bean program (Ph.D. Univ. Minnesota).
Dr. Howard F. Schwartz, bean pathologist
Dr. Richard Christie, plant virologist, Univ. of Florida, visiting CIAT for one month.
Dr. Michael D. Thung, bean program agronomist. Conducts preliminary yield trials and works on production problems including pest control.
Dr. Reinhardt Howeler, soil scientist in cassava program. Works on soil fertility and production practices. (Ph.D. Cornell Univ.; from Holland).
Dr. Dietrich Leihner, agronomist, cassava program. Works on cultural practices. (Ph.D. Univ. Giessen, Germany with research at CIAT, Colombia).
Dr. John K. Lynam, agricultural economics, cassava program. (Ph.D. Stanford Univ.).
Dr. Julio César Toro, agronomist, cassava program. (Ph.D. Purdue Univ.).
Dr. James M. Spain, soil scientist, pasture development, stationed at Carimagua, Colombia. (Ph.D. Purdue Univ.)
Dr. Carlos E. Lascano, animal scientist, tropical pasture program (Ph.D. Texas A & M Univ.).
Dr. Mario Calderón, entomologist, tropical pasture program.
Dr. Eugenia de Rubinstein, economist, tropical pasture program. (Ph.D. Univ. Minnesota; from Chile).
Ing. Joaquín González, agronomist, coordinator, rice program. (M.S. Cornell Univ.).
Ing. Johnson E. Douglas, coordinator, seed unit. (B.S. and M.S., Purdue Univ.).
Ms. Trudy Brekelbaum, editor, Library and Documentation Unit.
Ms. Susana Amaya, editor, Library and Documentation Unit.

F. CIAT visitors

1. Persons at CIAT to Teach Seed Technology Course

Dr. A. H. Boyd, Mississippi State Univ.
Ing. Edgar Cabrera, working on Ph.D. in seed technology, Mississippi State Univ.
Ing. Carlos Herrera, General Director, Hortus S.A. seed company (Las Camelias 790, San Isidro, Casilla 1544, Lima, Peru).

2. Persons at CIAT from Brazil to Talk on Alcohol from Cassava

Mr. Thorio Benedro de Souza Lima, Assistant to the Director, Petrobras (Av. Republica do Chile 65-23, Rio de Janeiro)
Mr. Urband Stumpf, Aeronautical Technical Center (CTA), San Jose Dos Campos, São Paulo); head of engine research.
Mr. Tobias Barreuto de Menezes, head, industrial fermentation, Food Technology Institute (ITAL), Campinas.

IV. PERU

A. Ministry of Agriculture and Food

Ing. Hugo Casas, Cuzco District; works as corn extension specialist.
Ing. David Mena, Head, Cuzco District, extension specialist.
Ing. Miguel Oscar Soto P., entomologist, stationed at Vista Florida, Chiclayo.
Dr. Victoria Rios R., plant protection specialist stationed at Vista Florida, Chiclayo.
Ing. Alberto Pisfil Llanton, entomologist, specialist in equipment calibration, stationed at Vista Florida, Chiclayo.
Ing. Roger Cirgahuala Q., Director of Extension and Ministry of Agriculture for Northern Region.

B. Instituto Nacional de Investigación Agraria (INIA) (Sinchi Roco 2728, Lince, Lima)

Dr. Javier Gazzo Fernandez D. Avila, Executive Director, formerly chemistry professor.
Dr. Carlos Valverde Suarez, Adjunct Executive Director, soil scientist (Ph.D. Purdue Univ.).
Ing. Pedro González, Subdirector in charge of research.
Ing. Jorge Ferreyros Flores, economist.
Ms. Kathy María Alva G., Public Relations.

1. Centro de Introducción y Cria de Insectos Utiles (CICIU), part of INIA. Located on La Molina Experiment Station but operated autonomously.

   Ing. Juan F. Pacora Rosales, Head, entomologist.
   Ing. Luis Valdivieso Jara, entomologist.
   Ing. Mary Whu de Araujo, entomologist.
   Ing. Elisabeth Nuñes Sacarias, entomologist.

2. La Molina Experiment Station (Apartado 2791, Lima 1)

   Ing. Manuel Llavería, Director.
   Ing. Pedro M. Gonzáles A., Associate Director.
   Ing. Manuel Delgado Peralta, entomologist, potato program.
   Ing. Angel Oviedo A., Head, Department of Plant Pathology.
   Ing. Renzo Urdanivia T., virologist, legume program.
   Ing. Eleodoro Herrera Alvariño, Head, Department of Nematology.
   Ing. Graciela Mendoza, plant pathologist, works on wheat rot.
   Ing. Junenai Salas, nematologist.
   Ing. Oscar G. Bullon Ferreyra, weed scientist, in charge of herbicide registration for Peru; worked in Tarapoto 1969-1975.
   Ing. Feliciano Avalos, entomologist, legume program.

3. Tarapoto Experiment Station, El Porvenir (Jr. San Martin No. 533, Apartado 9, Tarapoto)

   Dr. F. Oswaldo Vargas G., Director
   Ing. Dario Maldonado V., coordinator, research planning for the Northeast Region.
   Ing. Cesar R. Valles, plant pathologist, works on seed quality (spent summer 1979 at Univ. of Illinois with INTSOY program).
   Ing. Edison Cardenas Ramos, entomologist, cooperating with INTSOY pest management program.

Ing. Alfredo Solorzano Hoffman, research planning office, working on technology transfer.

4. Cuzco Experiment Station and headquarters for Cuzco District (Lechugal 401, Cuzco)

Ing. Cesar Quevedo, Director
Ing. Miguel Angel Pacheco, potato specialist
Ing. Erick Yabar Landa, entomologist
Ing. Roberto Horqque Ferro, legume program headquarters in Anta Substation

5. Chiclayo Experiment Station, Vista Florida and Northern Region (Apartado 116, Chiclayo)

Ing. Pompeyo Contreras Montenegro, Director of Northern Region.
Ing. Jorge Paz Torricelli, Head of research assessment for Northern Region.
Ing. Luis Navarrete Guzmán, Head of research projection for Northern Region.
Ing. José Hernández Leyton, Director of Vista Florida, rice agronomist
Ing. Alberto Cueva Angulo, Director of Huaraz Experiment Station Callejon de Huaylas.
Ing. Félix Chicoma P., Head, Department of Plant Protection.
Ing. Jorge Vélez G., agronomist, rice program, weed control.
Ing. Walter Larzarte P., soil scientist, analyses samples.
Dr. Victorio García, coordinator, bean program, plant pathologist (Ph.D. Cornell Univ.).
Ing. Angel Gastelo M., breeder, soybean program.
Ing. Rafael Olaya V., rice pathologist.
Ing. Consuelo Higaonna, plant pathologist, diagnostic center.
Ing. Elva Llontop C., Head, Department of Plant Pathology, works on bean viruses, chickpea *Fusarium* problems.

C. Universidad Nacional Agraria (UNA), La Molina (Apartado 456, Lima)

Ing. Mario Zapata Tejerina, Chancellor, entomologist (M.S. Texas A & M Univ.).
Ing. Guillermo Parodi Vera, Vice-chancellor, pasture management specialist.
Ing. Francisco Delgado de la Flor, Head, horticulture research program (M.S Turrialba, Costa Rica).
Dr. Fausto H. Cisneros Vera, Head, Department of Crop Protection, entomologist and Director of Graduate Studies. (M.S. North Carolina State Univ.; Ph.D. Univ. of California at Riverside).
Dr. Saloman Helfgott, weed scientist (Ph.D. with Dr. Ashton, University of California at Davis).
Dr. Teresa Icochea, plant pathologist.
Dr. Enrique N. Fernandez-Northcate, plant pathologist, works on resistance to viruses of potato and vegetables.
Ing. Ricardo Mont Koc, plant pathologist, works on resistance to cereal diseases.
Ing. Cesar Fribourg Solis, plant pathologist, works on viruses of potato and citrus.
Ing. Jaime Castillo Loayza, plant pathologist, works on corn viruses.

Ing. Leonor Mattos Calderon, plant pathologist, works on diseases of legumes and on seed pathology.
Ing. Manuel Canto Saenz, nematologist (at Cornell receiving Ph.D.).
Dr. Julio A. Echevarrea, Head, Agricultural Economics Department. (M.S. at Univ. of Minnesota, Ph.D. at Iowa State Univ.).
Ing. Ricardo Sevilla P., Director, National Corn Program.
Ing. Alfonso Cerrate V., agronomist, National Corn Program. (Ph.D. Univ. Nebraska; also studied at Iowa State Univ. and at Purdue Univ.).
Ing. Roberto Centreras Malaga, National Corn Program, stationed in Callejon de Hualas, works on technology transfer to small farmers.
Ing. Juan Herera, entomologist, cotton.
Ing. Jorge Saramiento, entomologist, corn.
Dr. Menandro Ortiz, entomologist, in charge of entomology museum.

D. Universidad Nacional Pedro Ruiz Gallo (Apartado 10, Lambayeque)

Dr. Carlos Panizo, Director of Research, virologist (Ph.D. North Carolina State Univ.).
Ing. Alberto Jimenes, plant pathologist, fungal root rots.
Ing. Enrique Cabanillas Q., nematologist. (M.S. Univ. Florida).
Ing. Angel Diaz Celiz, botany taxonomist, including identification of weeds.
Ing. Luis Cerna Bazan, weed scientist. (M.S. São Paulo, Brazil).
Ing. Pedro Arbulu Diaz, economist.
Ing. Manuel Torres, Head, Department of Entomology.
Ing. Luis Castillo, Director of Extension, rice extension specialist.

E. Universidad Nacional, Cuzco (Apartado 367, Cuzco)

Ing. Rene Chaves Alfar, plant breeder
Ing. Roberto Mendoza, plant breeder
Dr. José A. Escalante G., Head, crop protection (did not meet).
Ing. Luis Sumar Kalinoski, entomologist, worked on muña and its effects on insects of potato (did not meet).

F. Union Carbide Pan-America Inc. (Apartado 165, Lima 18).

Ing. Pedro Alcalá, entomologist
Dr. Carlos Olivares
Ing. Benjamin Rey Tordoya, Head of product development, RODVA (Av. Los Ferroles 349, Urbanizacion Bocanegra, Lima).

G. Rhone-Poulenc Andina S.A. (Gral. Iglesias 608, Lima 18).

Ing. Nelson Larrea Lora, Technical Assistant
Ing. J. Manuel Lucena Ugaz, weed scientist (M.S. CIAT, with Jerry Doll).

H. BASF Peruana S.A. (Oscar R. Benavides 5915, Callao 3, Casilla 3911, Lima 10).

Ing. Telmo de la Cruz M., Agricultural section

I. CIBA-GEIGY, South America Agrochemical Division (Av. Larco 1013-Of. 202, Lima 18).

Ing. Juan Rodolfo Vidalon V., teaches beginning weed science course at UNA-La Molina.

J. Japanese Company Specializing in Freezing Vegetables (Av. Sta. María 139-4, Miraflores, Lima).

Dr. Alfredo Montes, Freezes carrots, beans, peas, broccoli for export to Japan. Works on post harvest physiology of vegetable crops (Ph.D. Univ. Florida).

K. USAID Mission/Peru (Av. España 386, Lima)

Mr. Leonard Yaeger , Mission Director
Mr. John B. O'Donnell, Rural Development Officer
Dr. Loren L. Schulze, Agricultural Specialist, in charge of in-country Title XII CRISP's.
Mr. Jack D. Rosholt, in charge of Tarapoto Development Program.
Mr. John Davison, Comptroller
Mr. Steve Whitman, Lawyer
Mr. Ed Kadunc, Loan Officer
Mr. Manuel González, Research, education, and extension project director for Tarapoto area.
Ms. Liliana Cruz C., typist

L. Centro Internacional de la Papa (CIP) (Apartado 5969, Lima)

Dr. Richard L. Sawyer, Director General
Dr. Manuel Piña, Head, training and communications. (Ph.D. Texas A & M Univ.)
Dr. Parvis Jatala, Head, Department of Entomology and Nematology, nematologist (Ph.D. Oregon State Univ.).
Dr. Syed Anwan H. Rizvi, breeder/virologist.
Dr. Juan Landeo, breeder/geneticist (Ph.D. Univ. of Wisconsin).
Ing. Herbert Torres M., plant pathologist, working on wart diseases (CIP, Huancayo, Santa Isabela 1996, Huancayo). Met in Anta Experiment Station near Cuzco.
Dr. John Niederhauser, consultant for regional Central American potato project. Met in Costa Rica. (2474 North Camino Valle Verde, Tucson, AZ 85715).
Dr. William J. Hooker, Head, Department of Plant Pathology, Potato virus specialist, author of Potato Disease Compendium (Ph.D. University of Wisconsin).

APPENDIX B

SOME IMPORTANT WEEDS IN THE AREAS VISITED

Atlantic Zone of Costa Rica

Scientific Name	Family	Annual A or Perennial P
Cynodon dactylon	Gramineae	P
Digitaria spp.	"	A
Eleusine indica	"	A
Panicum maximum	"	P
Panicum fasciculatum	"	A
Paspalum paniculatum	"	P
Paspalum virgatum	"	P
Rottboellia exaltata	"	A
Setaria barbata	"	P
Cyperus rotundus	Cyperaceae	P
Amaranthus spp.	Amaranthaceae	A
Bidens pilosa	Compositae	A
Drymaria cordata	Caryophyllaceae	A
Hemidiodia ocimifolia	Rubiaceae	A

Cauca Valley of Colombia

Scientific Name	Family	Annual A or Perennial P
Cynodon dactylon	Gramineae	P
Digitaria spp.	"	A
Echinochloa colonum	"	A
Echinochloa crus-galli	"	A
Elusine indica	"	A
Oryza sativa (red rice)	"	A
Panicum maximum	"	P
Paspalum virgatum	"	P
Rottboellia exaltata	"	A
Cyperus rotundus	Cyperaceae	P
Amaranthus spp.	Amaranthaceae	A
Bidens pilosa	Compositae	A
Euphorbia spp.	Euphorbiaceae	A
Ipomea spp.	Convolvalaceae	A
Portulaca oleracea	Portulacaceae	A

Irrigated North Coast of Peru

Scientific Name	Family	Annual A or Perennial P
Cynodon dactylon	Gramineae	P
Echinochloa colonum	"	A
Echinochloa crus-galli	"	A
Leptochloa uninervia	"	A
Sorghum halepense	"	P
Commelina fasciculata	Commelinaceae	A or P
Heteranthera reniformis	Ponterderiaceae	A or P
Cyperus difformis	Cyperaceae	P
Cyperus esculentus	"	P
Ammania coccinea	Lytraceae	
Bidens pilosa	Compositae	A
Eclipta alba	Compositae	A
Ipomea reptans	Convolvulaceae	A
Ipomea heptaphyla	"	A
Jussiaea erecta	Onagraceae	
Sesbania exasperata	Leguminosae	A

Irrigated Coast of Peru - La Molina

Scientific Name	Family	Annual or Perennial P
Amaranthus spp.	Amaranthaceae	A
Chenopodium album	Chenopodiaceae	A
Chenopodium hirsinus	"	A
Datura stromonium	Solanacae	A
Galinsoga spp.	Compositae	A
Nicandra physalodes	Solanaceae	A
Portulaca oleracea	Portulacaceae	A
Trianthema portulacastrum	Aizoaceae	A or P

Jungle Area near Tarapoto, Peru

Echinochloa spp.	Gramineae	A
Imperata cylindrica	"	P
Rottboellia exaltata	"	A
Cyperus rotundus	Cyperaceae	P
Ipomea spp.	Convolvulaceae	A
Sida spp.	Malvaceae	A

Highland Areas of Peru

Scientific Name	Family	Annual or Perennial P
Avena fatuna	Gramineae	A
Paspalum candidum	"	A
Pennisetum clandestinum	"	P
Poa annua	"	A or P
Amaranthus spp.	Amaranthaceae	A
Bidens pilosa	Compositae	A
Brassica spp.	Cruciferae	A
Chenopodium spp.	Chenopodiaceae	A
Datura stromonium	Solanaceae	A
Ipomea spp.	Convolvulaceae	A
Senecio vulgaris	Compositae	A
Urticae urens	Urticaceae	A

APPENDIX C

SOME DISEASES OF IMPORTANT SMALL FARM CROPS IN CENTRAL AMERICA, COLOMBIA AND PERU

Banana (*Musa sapientum* L.)

Common Name	Causal Organism
sigatoka	*Mycosphaerella musicola* (*Cercospora musae*) (Black Sigatoka became very important in Costa Rica last year)
bacterial wilt	*Pseudomonas solanacearum*
wilt (Panama Disease)	*Fusarium oxysporum* f. sp. *cubense*
black end	*Gleosporium musarum*
Roxana Disease	virus
Cucumber Mosaic	virus
nematodes	*Radopholus similis*
lesion nematode	*Pratylenchus musicola*
root knot nematode	*Meloidogyne* spp.
leaf spot	*Cordana musae*
stem rot	*Erwinia chrysantheum*

Barley (*Hordeum vulgare* L.) and Wheat (*Triticum aestivum* L.)

Common Name	Causal Organism
rust	*Puccinia graminis* *Puccinia recondita* *Puccinia striiformis*
barley yellow dwarf	virus
powdery mildew	*Erysiphe graminis*
scald	*Rhynchosporium secalis* (barley only)
culm rot	*Sclerotium rolfsii*
smuts	*Ustilago* spp.

Bean (Phaseolus vulgaris L.)

Common Name	Causal Organism
angular leaf spot	Isariopsis griseola
powdery mildew	Erysiphe polygoni
web blight	Rhizoctonia microslerotia
rust	Uromyces phaseoli f. sp. typica
halo blight	Pseudomonas phaseolicola
common blight	Xanthomonas phaseoli f. sp. fuscans
anthracnose	Colletotrichum lindemuthianum
Rhizoctonia root rot	Rhizoctonia solani
Sclerotinia wilt	Sclerotinia sclerotiorum
root rot	Fusarium solani f. sp. phaseoli
Ascochyta leaf spot	Ascochyta boltshauseri
white spot	Chaetoseptoria wellmanii
ashy stem blight	Macrophomina phaseoli
root knot nematodes	Meloidogyne spp.
downy mildew	Phytophthora phaseoli
Cucumber Mosaic	virus
Bean Common Mosaic	virus
Curly Top	virus
Bean Yellow Mosaic	virus
Pythium root rot	Pythium ultimum, P. debaryanum, P. aphanidermatum
southern blight	Sclerotium rolfsii

Cabbage (*Brassica* *oleraceae* L.)

Common Name	Causal Organism
black rot	*Xanthomonas campestris*
drop rot	*Sclerotinia sclerotiorum*
gray leaf spot	*Alternaria brassicae*
brown rot	*Alternaria brassicicola*
downy mildew	*Peronospora parasitica*
yellows	*Fusarium oxysporum* f. sp. *conglutinans*
black leg	*Phoma lingam*
powdery mildew	*Erysiphe polygoni*
bottom rot	*Rhizoctonia solani*
stem rot	*Erwinia carotovora*
mosaic	Virus
root knot nematodes	*Meloidogyne* sp.

Cassava (*Manihot* *esculenta* Crantz)

Common Name	Causal Organism
bacterial blight	*Xanthomonas manichostis*
Cassava mosaic	virus
Cassava common mosaic	virus
witches broom	mycoplasma
brown leaf spot	*Cercospora henningsii*
white leaf spot	*Cercospora caribaea*
blight leaf spot	*Cercospora vicosae*
Cassava ash	*Oidium manihotis*
superelongation	*Sphaceloma manihoticola*
stem rot	*Glomerella cingulata*
root rot	*Phytophthora drechsleri*
root rot	*Sclerotium rolfsii*

bacterial stem rot	Erwinia sp.
concentric-ring leaf spot	Phoma sp.
anthracnose	Colletotrichum manihotis
rust	Uromyces spp.

Citrus (Citrus sp.)

Common Name	Causal Organism
scab	Elsinoe fawcetti
powdery mildew	Oidium tingitaninum
pink disease	Corticium salmonicolor
brown rot	Phytophthora citrophthora
blight	Phytophthora palmivora
blue mold	Penicillium italicum
anthracnose	Glomerella cingulata
melanose	Diaporthe citri
Tristeza	virus
Psorosis	virus
Xyloporosis	virus
Exocortis	virus
Citrus stubborn	virus
Papaya ringspot	virus
foot rot	Phytophthora parasitica
gummosis	Botrytis cinerea
lesion nematode	Pratylenchus sp.
nematode	Tylenchulus semi-penetrans

Coffee (Coffea arabica L.)

Common Name	Causal Organism
brown spot	Cercospora coffeicola
scald	Phoma costarricensis
rooster's eye	Mycena citrocolor

wound disease	*Ceratocystis fimbriata*
thread blight	*Pellicularia koleroga*
damping-off	*Rhizoctonia solani*
pink disease	*Corticium salmonicolor*
dieback	*Colletotrichum coffeanum*
leaf spot and stem rot	*Myrothecium roridum*
rust	*Hemileia vastatrix*
zonal leaf spot	*Cephalosporium zonatum*
Mancha mantecosta	virus
root knot nematode	*Meloidogyne* spp.
root lesion	*Pratylenchus* sp.
secondary root rot	*Rosellinia bunodes*,
Sclerosis	*Sclerotium coffeicolum*

Corn (*Zea mays* L.) and Sorghum (*Sorghum vulgare* Pers.)

Common Name	Causal Organism
stalk rot	*Gibberella zeae* (*Fusarium graminearum*)
leaf blight	*Gibberella fujikuroi* (*Fusarium moniliforme*) *Helminthosporium turcicum*, *H. maydis*, *H. carbonum*
rust	*Puccinia sorghi* (*P. polysora*)
ear rot	*Rhizopus* spp. *Aspergillus* spp. *Penicillium* spp., *Gibberella zeae*, *Fusarium* spp., *Diplodia* spp.
brown spot	*Physoderma maydis*
gray leaf spot	*Cercospora zeae-maydis* and *C. sorghi*
yellow leaf spot	*Phyllosticta* sp.
tar spot	*Phyllachora maydis*
Maramius leaf spot	*Marasmius* sp.
smut	*Ustilago maydis*
Cercosporella leaf spot	*Cercosporella* sp.

Mosaic, Maize Mosaic Virus, Corn Strunt, Spiroplasm, Maize Rayado Fino Virus, Mycoplasms, Maize Chlorotic Dwarf Virus, Maize Dwarf Mosaic, Sugarcane Mosaic, Maize Rayado Columbiano, etc.	Numerous viruses and/or mycoplasmas
downy mildew	*Sclerospora graminicola*
anthracnose	*Colletotrichum graminicola*
Zonate leaf spot	*Gloeocercospora sorghi*

Onion (*Allium cepa* L.)

Common Name	Causal Organism
downy mildew	*Peronospora destructor*
meck rot	*Botrytis allii*; *B. byssoidea*; *B. squamosa*
black mold	*Aspergillus niger*
blue mold	*Penicillium* sp.
purple blotch	*Alternaria porri*
Fusarium root rot	*Fusarium oxysporum* f. *cepae*
smudge	*Colletotrichum circinans*
bacterial soft rot	*Erwinia carotovora*
bulb nematode	*Ditylenchus dipsaci*
damping-off	*Rhizoctonia solani*
white rot	*Sclerotinia cepivorum*
black stalk rot	*Stemphylium botryosum*

Papaya (*Corica papaya* L.)

Common Name	Causal Organism
ring spot	unidentified virus
root rot	*Phytophthora palmivora*
root rot	*Pythium aphanidermatum*
fruit rots	various fungi

Pea (Pisum sativum L.)

Common Name	Causal Organism
root and stem rots	Fusarium (most important), Rhizoctonia, Pythium, Sclerotinia, Macrophomina, Aphanomyces.
leaf spot	Cercospora lathyrina
root knot nematode	Meloidogyne spp.

Potato (Solanum tuberosum L.)

Common Name	Causal Organism
late blight	Phytophthora infestans
early blight	Alternaria solani
common scab	Streptomyces scabies
brown rot	Pseudomonas solanacearum
soft rot	Erwinia carotovora
black scurf	Rhizoctonia solani
root knot nematodes	Meloidogyne spp.
Golden nematode	Globodera sp.
Potato virus X, Potato virus A, Potato virus Y, Leaf Role virus	viruses
root rot	Fusarium spp.
southern blight	Sclerotium rolfsii
black leg	Erwinia atroseptica

Rice (Oryza sativa L.)

Common Name	Causal Organism
rice blast	Piricularia oryzae
sheath spot	Corticium sasakii
brown spot	Helminthosporium oryzae
white leaf	virus
black sheath rot	Ophiobolus oryzinus

Soybean (Glycine max L.)

Common Name	Causal Organism
downy mildew	Peronospora manshurica
soybean mosaic	virus
bean yellow mosaic	virus
golden mosaic	virus
bacterial pustle	Xanthomonas phaseoli
brown spot	Septoria glycines
anthracnose	Colletotrichum truncatum
pod and stem blight	Diaporthe phaseolorum
machismo	

Tobacco (Nicotiana tabacum L.)

Common Name	Causal Organism
root knot nematodes	Meloidogyne spp.
blue mold	Peronospora tubacina
black shank	Phytophthora parasitica
tobacco mosaic	virus
black leg	Erwinia carotovora

Tomato (Lycopersicon esculentum Mill)

Common Name	Causal Organism
late blight	Phytophthora infestans
early blight	Alternaria solani
anthracnose	Colletotrichum phomoides
bacterial canker	Corynebacterium michiganense
bacterial wilt	Pseudomonas solanacearum
leaf mold	Cladosporium fulvum
Fusarium wilt	Fusarium oxysporum f. sp. lycopersici
leaf spot	Septoria lycopersici
root knot nematode	Meloidogyne incognita

root necrosis (nematode)	*Pratylenchus pratensis*
Spiral nematode	*Helicotylenchus* sp.
Potato Leaf Roll	virus
TMV	virus
Peruvian Tomato Virus	virus
fruit rot	*Sclerotinia* sp.
leaf spot	*Stemphylium* sp.

APPENDIX D

CENTRO AGRONOMICO TROPICAL DE INVESTIGACION Y ENSEÑANZA
Program of Annual Crops

CATIE

PROVISIONAL LIST OF INSECT AND MITE PESTS OF FOOD CROPS IN CENTRAL AMERICA

A.B.S. King

Second part of the progress report of the entomologist attached to the CATIE cropping systems programme to the Ministry of Overseas Development of the UK Government.

Turrialba, Costa Rica
1978

KING, A.B.S.* Provisonal list of insect and mite pests of food crops in Central America.** Turrialba, Costa Rica, CATIE 1978. 9p.

SUMMARY

This paper presents a provisional list of common insect and mite pests found by the author on some crops grown by small farmers in Costa Rica, Nicaragua and Honduras from 1975 to 1977. Details of the regions where they were found and of the type of damage are included for the following crops: maize, vigna, sweet potato, cassava, curcubitae, tomato and egg-plant, dasheen and pigeon pea. Although this list is incomplete, it was nevertheless considered useful in giving a working base, and to serve as a provisional index to the insect pest reference collection at CATIE.

This publication forms the second part of the progress report of the entomologist, attached to the CATIE small farmer cropping systems programme, for the UK government Ministry for Overseas Development.

RESUMEN

Se presenta una lista provisional de las plagas más comunes, encontradas por el autor, en algunos cultivos producidos por pequeños agricultores en Costa Rica, Nicaragua y Honduras desde 1975 hasta 1977. Se incluye información de las regiones donde se los ha encontrado y del tipo de daño causado en los siguientes cultivos: maíz, frijol, caupí, camote, yuca, repollo, rábano, pepino, tomate y berengena, taro y gandúl. Esta lista no es completa, sin embargo se considera que podría ser una base útil para el trabajo de entomología y servir como índice provisional para la colección de referencia de insectos del CATIE.

Esta publicación es la segunda parte del informe de progreso del autor, quien trabaja para el programa de Sistemas de Cultivos para Pequeños Agricultores del CATIE; para el Ministerio de Desarrollo Ultramarino del Gobierno de Gran Bretaña.

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* Ph.D., Entomologist, CATIE

** Second part of the progress report of the entomologist attached to the CATIE cropping systems programme submitted to the Ministry of Overseas Development of the U.K. Government.

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PROVISONAL LIST OF INSECT AND MITE PESTS OF FOOD CROPS IN CENTRAL AMERICA*

A.B.S. King**

1. INTRODUCTION

Insects found damaging crop plants in the areas visited in Costa Rica, Nicaragua and Honduras were collected, larvae reared to adult where possible and specimens sent to the Commonwhealth Institute of Entomology or to the Systematic Entomology Laboratory, USDA, Florida for identification. Basic biological data were recorded and specimens mounted for the CATIE reference collection.

Mejor and/or important pests are market with an asterisk. Those marked CA (Central America) are known to be well distributed through out the region. The letters CR, Nic, Hond, indicate the countries (Costa Rica, Nicaragua and Honduras) where this insect was found damaging a specific crop but does no necessarily mean geographical restriction to that country. Altitude or climate specific pests are so indicated meaning greater abundance at, not necessarily restriction to that altitude or climatic zone. The park of the crop attacked is indicated by the following key:

Leaves (L), Steam cut (C), Roots (R), Tubers (T), Stem-borer (S), Fruit or seed (F), Shoot borer (Sh), Virus transimission (V), Flowers (Fls)

2. LIST OF PESTS

2.1 MAIZE (Zea mays) Maíz

Lepidoptera

Agrotis ipsilon Hufn.	(Noctuidae)	C.A.	C.
A. subterranea F.		C.A.	C.
Heliothis zea Boddie		C.A.	F
Mocis latipes (Gn)		Hond.	L
* Spodoptera frugiperda Smith & Abbott		C. A.	CLF

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** Ph.D., Entomologist, CATIE

S. sunia Gn.		C.A.	4000 ft.	L
Diatraea lineolata Wlk.	(Pyralidae)	C.A.		S
D. guatemalella Schaus		C.R.		S
Elasmopalpus lignosellus Zeller		C.A.		S,Sh
Hemiptera				
Aphis maidis (Fitch)	(Aphididae)	C.A.		L
Cyrtomenus sp	(Cynidae)	C.R.		R
Dalbulus maidis (Delong & W.)	(Cicadellidae)	Nic.		LV
Coleoptera				
Anomala cincta Say.	(Scarabaeidae)	C.A.		R
A. discoidalis Bates		C.R.		R
A. forminosa Bates		C.R., Hond.		R
Cyclocephala lunulata Burm.		C.R.		R
Ligyrus nasutus Burm.		Nic.		R
*Phyllophaga sp (S 23A)		C.A.		R
Ph. obsoleta Blanch.		C.R.	6000 ft.	R
* Ph. parvisetis?		C.A.	low rainfall	R
* Diabrotica balteata (LeConte)	(Chrysomelidae)	C.A.		LR
D. porracea Har.		C.R.	6000 ft.	LR
D. viridula (F)		C.R.		L
Epitrix sp.		C.R.		L
Metachroma variabile Jac.		Nic.		L
Colopterus posticus (Er.)	(Nitidulidae)	C.R.		F
C. stenoides Murr.		C.R.		F

2.2 BEANS (Phaseolus vulgaris) Frijol, (Vigna sinensis) caupí

Lepidoptera

* Agrotis ipsilon Hufn.	(Noctuidae)	C.A.		C
* A. subterronea F.		C.A.		C
Spodoptera eridania Stoll.		C.R.	Low rainfall	CL
S. frugiperda (Sm. & Abb.)		C.A.		C
Lamprosema indicata (F)	(Pyralidae)	Hond.		L
Maruca testulalis Geyer		C.R.		F
* Estigmene acraea Ivory	(Arctiidae)	Hond.		LF
Urbanus sp nr esmeraldus Butler	(Hesperiidae)	C.R.		L
<u>Hemiptera</u>				
Aphis fabae (Scop)	(Aphididae)	C.R.		L
Myzus persicae (Sulzer)		C.R.	(4000 ft)	L
* Empoasca sp. sensu lat.	(Cicadellidae)	C.A.	(C.R.)	L
Spissistilus festina (Say)	(Membracidae)	C.R.		L
Stricticephala sp.?bubalus (Fabr)		C.R.		L(R)
Strictolobus sp.		C.R.		L
Halticus bracteatus (Say.)	(Miridae)	C.R., Hond.		L
Prepops latipennis (Stal)				L
Nezara viridula (L)	(Pentatomidae)	C.A.		FL
<u>Coleoptera</u>				
Altica sp	(Chrysomelidae)			Nic
Ceratoma atrofasciata		Hond. Nic. CR(NW)	Low rainfall	LV
C. ruficornis (Oliv.)		C.A.	Low rainfall	LV
C. ruficornis rogersi Jac.		C.R.	high rainfall	LV
C. salvini		C.R. (SW)		L
Diabrotica adelpha Har.		C.R.		LV

	D. balteata (Le Conte)		C.A.	LV
	D. nigrofasciata Jac.		(Guat)	L
	D. octoplagiata Jac.		Nic.	L
	D. pulchella Jac.		C.R.	L
	D. variabilis Jac.		C.R.	L
	Diphaulaca nr. panamae Barber		C.R. (SW), Nic.	LR
	Nodonota spp		C.A.	L
	Paranapiacaba waterhousei (Jac)		C.R.	L
	Promecosoma viride Lef.		Nic.	L
	Systena S-littera (L)		C.R.	LV
	Exophthalmus jekelianus White	(Curculionidae)	C.R.	L
	(*) Apion godmani (Wagner)	(Apionidae)	Hond., Nic.	F
	Phyllophaga spp	(Scarabaeidae)	C.A.	R
	(*)Epilachna varivestis Muls.	(Coccinellidae)	(El Salvador)C.A.	L
	Hymenoptera			
	Atta spp (Cowpea only)	(Formicidae)	C.R.	L
	Solenopsis geminata group		C.R.	Ring-barking
	Diptera			
	Hylemya platura (Meyer)	(Anthomyiidae)	C.R.	Sh
	Acari			
	Oligonychus sp	(Tetranychidae)	C.R.	L
	Polyphagotarsonemus latus	(Tarsonemidae)	C.R.	L
2.3	SWEET POTATO (Ipomoea batatas)	Camote		
	Lepidoptera			
	Agrius cingulatus F.	(Sphingidae)	C.R.	L

Agrotis ipsilon Hufn.	(Noctuidae)	C.A.	L,C
A. repleta Walk.		C.R.	L,C
A. subterranea F.		C.A.	L,C
Bleptina confusalis Gn.		C.R.	L
Eriopyga spp.		C.R.	L
Monodes deltoides Möschl.		C.R.	L
M. nucicolora Gn.		C.R.	L
Spodoptera dolichos F.		C.R.	L
S. eridania Stoll.		C.R.	L
S. latifascia Walk		C.R.	L
Trichoplugia ni Hb.		C.A.	L
Ecpanthenia caudata Walk.	(Arctiidae)	C.R.	L
Estigmene columbiana Roths.		C.R.	L
Compacta hirtalis Gn.	(Pyralidae)	C.R.	ST
Megastes sp.		C.R.	S
* Polygrammodes elevata F.		C.R.	ST
Hemiptera			
Complex of Cicadellidae:			L
Empoasca, Tylozygus, Catagonia spp.		C.A.	L
Coleoptera			
Diabrotica adelpha Har.	(Chrysomelidae)	C.A.	L
D. balteata (Le Conte)		C.R.	L
Typhorus chalceus Jac.		C.R.	L
(*)T. nigritus (F)		C.R.	L,T
Stenygra histria Serv.	(Cerambycidae)	Hond.	S
(*) Rhyssomatus subcostatus Fahr.	(Curculionidae)	C.R.	T,S

(*) Phyllophaga spp.	(Scarabaeidae)	C.R.	R
Hymenoptera			
(*) Atta spp.	(Formicidae)	C.R.	L

2.4 CASSAVA (Manihot utilissima) Yuca

Lepidoptera			
Erynnis alope Drury	(Sphingidae)	C.R.	L
E. ello L.		C.R.	L
Agrotis ipsilon Hfn.	(Noctuidae)	C.R.	C
Diptera			
Anastrepha manihoti Costa Lima	(Tephritidae)	C.R.	S
Silba? perezi Rom. & Rup.	(Lonchaeidae)	C.R.	Sh
Eudiplosis brasilensis Rubsaamen	(Cecidomyiidae)	C.A.	L
Hymenoptera			
(*) Atta sp	(Formicidae)	C.A.	L
Coleoptera			
Phyllophaga spp	(Scarabaeidae)	C.A.	T

2.5 RICE (Oryza Sativa , Arroz

Lepidoptera			
Rupela albinella (Cram)	(Pyralidae)	C.R.	S
Hemiptera			
* Blissus leucopterus Say	(Lygaeidae)	C.R.	R
Draeculacephala sp.	(Cicadellidae)	C.R.	L
Hortensia similis (Walk)		C.R.	L
Collaria oleosa (Dist.)	(Miridae)	C.R.	L
Garganus albidivittis Stal		C.R.	L
Oliarus sp	(Cixiidae)	C.R.	L

2.6 CRUCIFERAE (Brassica oleracea; B. chinensis, Raphanus sp.) Repollo - rábanos

Lepidoptera

(*)Ascia monuste L.	(Pieridae)	C.R.	L
(*) Leptophobia eleusis Lucas		C.R.	L
Agrotis subterranea F.		C.A.	L
(*) Trichoplusia ni Hb	(Noctuidae)	C.R., Hond.	L
Hellula fidealis Walk.	(Pyralidae)	C.R.	T,S, petioles
* Plutella maculipennis (Curtis)	(Yponomeutidae)	C.A.	L

Hemiptera

(*) Lipaphis erysimi (Kattenbach)	(Aphididae)	C.A.	L
Myzus persicae (Sulzer)	(Aphididae)	C.R.	L

2.7 CUCURBITAEAE (Cucurbita moschata, Cucumis sativus) Ayote, Pepino, etc.

Lepidoptera

(*) Diaphania hyalinata L.	(Pyralidae)	C.R.	S,F
* D. nitidalis (Stoll)		C.A.	S,F
Melittia cucurbitae (Harris)	(Sesiidae)	C.R.	S

Coleoptera

Phyllophaga spp	(Scarabaeidae)		R
Acalymma coruscum (Har)	(Chrysomelidae)	C.R., Hond.	L, Fls.
A. theimei (Baley)		C.R.	L, Fls
A. vittata F.		C.R.	L, Fls
Diabrotica adelpha Har.		C.R.	L, Fls
D. balteata (Le Conte)		C.A.	L, Fls
Paranapiacaba waterhousei (Jac.)		C.R.	L, Fls
Epilachna borealis (F)	(Coccinellidae)	C.A.	L

Hemiptera			
Anasa andresi Guer.	(Coreidae)	C.R.	L
SOLANACAE (Lycopersicon esculentum; Solanum melongena' Tomate, Berengena			
Lepidoptera			
Agrotis subterranea F.	(Noctuidae)	C.A.	C
Heliothis zea Boddie		C.A.	F
Spodoptera frugiperda (Sm.&Abb.)		C.A.	F
S. latifascia Walk.		C.R, Hond.	F,L
S. sunia Gn.		C.R.	F,L
Trichoplusia ni Hb.		CR. Hond.	L
Coleoptera			
Chaetocnema sp.		C.A.	L
Hemiptera			
Myzus persicae (Sulz)	(Aphididae)	C.A.	L
Phthia picta (Drury)	(Coreidae)	C.R., Hond.	F,L
Halticus bracteatus (Say)	(Miridae)	C.R.,Hond.	L
Acarina			
OligoNychus sp?	(Tetranychidae)	C.R.	L
2.8 L. DASHEEN	(Calocasia esculenta) Taro		
Hemiptera			
Corythuca gossypii (Fabr.)	(Tingidae)	C.R.	L
2.9 PIGEON PEA	(Cajanus cajan)Gandúl		
Lepidoptera			
Anticarsia gemmatalis (Huba)	(Noctuidae)	C.R.	L
Heliothis virescens (F)		C.R.	F
Maruca testulalis Geyer	(Pyralidae)	C.R.	F

Hemiptera

Leptoglossus zonatus (Dallas)	(Coreidae)	C.R.	L.F
Euschistus crenator (Fabr.)	(Pentatomidae)	C.R	L.F
Nezara viridula (L.)		C.R.	L.F

FITO: 822-78
Abril 26, 1978
AK/mdem

APPENDIX E-1

UNITED STATES DEPARTMENT OF AGRICULTURE
SCIENCE AND EDUCATION ADMINISTRATION

AGRICULTURAL RESEARCH
NORTHEASTERN REGION
BELTSVILLE AGRICULTURAL RESEARCH CENTER
BELTSVILLE, MARYLAND 20705

June 19, 1980

Dr. Roberto H. Gonzalez
Professor of Entomology
Faculty of Agronomy
University of Chile
Casilla 1004, Santiago, Chile

Dear Dr. Gonzalez:

Please excuse my delay in responding to your letter about research on and identification of insects and mites of agricultural and plant quarantine significance. Your letter of May 6 did not arrive here until May 22, and my further delay is due to the fact that I have been "acting" for the Biological Control and Insect Taxonomy position in our National Program Staff. You may be interested to know that that position, from which D. E. Bryan retired over a year ago, will be filled in the near future.

Yes, indeed, I recall our correspondence and discussions about the critical situation facing insect and mite taxonomic research and services in general, and the specific situation in Mexico, Central and South America. As about 10% of the 1/3 million specimens that our USDA Systematic Entomology Laboratory (SEL) identifies annually comes from Mexico and Central and South America we are confronted with the problems almost daily. Although most of the thousands (probably tens of thousands) of specimens identified by SEL for Latin American countries have been returned to collections there, and thus, with the specimens identified locally have helped to build up reference collections I fully realize that this can be only a small portion of the reference material needed. Exchanges of specimens and particularly identification of additional specimens by experts throughout the world are needed, along with many other activities and physical improvements to build up in-country taxonomic capability.

Dr. Jack Lattin at Oregon State University and I conducted a detailed survey of taxonomic service needs in Latin America last year; this has given us some solid statistics that we will be publishing soon. Dr. Michael Irwin recently participated in a US-AID survey of pest-management research needs, including taxonomic services, in several Central and South American countries, and we can expect further detailed information on the nature of the research and service needs. As Dr. Lattin and Dr. Irwin are vitally interested in the matters raised in your letter I am taking the liberty of sending them copies of your May 6 letter and this reply.

I would be most interested in corresponding with you in more detail about these matters. I would be especially interested in your views concerning the place of WHO in assisting with solutions. It has always amazed me that WHO appears to be relatively uninformed and not particularly involved in the area of identification work.

For many years the USDA had an open-ended identification policy, identifying practically anything for anyone. Budget and staffing limitations and increasing need to produce more research information forced us to limit our service to the Western Hemisphere in June, 1977. We still try to meet all requests for identifications from Mexico, and Central and South America.

The box of specimens referred to in your letter of May 6 has been received and distributed to the SEL taxonomists for identification. I hope to return the identified material to you shortly.

With regard to your list, "Pest Interceptions from Chilean Fruit Prior to Mandatory Fumigation Requirements" I have indicated by L (= literature) or S (= specimens) where we have been able to provide you with reference material. The publications are enclosed and the specimens are being sent under separate cover.

Enclosed here are a few items about our organization that may be of interest.

I look forward to hearing from you further.

Sincerely yours,

LLOYD KNUTSON, Chairman
Insect Identification and Beneficial
Insect Introduction Institute

Enclosures

cc: M. Irwin

APPENDIX E-2

SURVEY OF COLLECTIONS, ENTOMOLOGICAL LIBRARIES AND TAXONOMISTS

In

CENTRAL AMERICA AND PANAMA

And

Recommendations Bearing on the Possible Establishment

Of A

REGIONAL INSECT IDENTIFICATION LABORATORY

By

Dr. Edward L. Todd, Systematic Entomologist
Entomology Research Division, ARS/USDA

UNITED STATES DEPARTMENT OF AGRICULTURE

Cooperating With

AGENCY FOR INTERNATIONAL DEVELOPMENT
REGIONAL OFFICE FOR CENTRAL AMERICA AND PANAMA (ROCAP)
AND
INTERNATIONAL REGIONAL ORGANIZATION FOR AGRICULTURAL SANITATION (OIRSA)

REPORT ON A SURVEY OF COLLECTIONS, ENTOMOLOGICAL LIBRARIES AND TAXONOMISTS IN CENTRAL AMERICA AND PANAMA AND RECOMMENDATIONS BEARING ON THE POSSIBLE ESTABLISHMENT OF A REGIONAL INSECT IDENTIFICATION LABORATORY

BACKGROUND

During the period October 14, 1967 to November 21, 1967, Dr. E. L. Todd conducted a survey in Central America and Panama of entomological collections, libraries, and taxonomists as a preliminary to the possible establishment of an insect identification laboratory in the area. This survey was conducted at the request of the Ministers of Agriculture (and OIRSA) as an OIRSA activity in conjunction with ROCAP of U. S. AID. The original request was for one specialist in Insect and Disease Identification. Dr. Todd is not a specialist in Plant Disease Identification, and therefore, his report relates only to the possible establishment of an insect identification laboratory. If both services were to be established at one place for administrative and space economy reasons, additional allowances would need to be made for the plant disease identification part of the laboratory. The requests for assistance and stated objectives of Dr. Todd's mission differed according to the organization, USDA, ROCAP, OIRSA. Specific actions for some of the requests could not be developed for this report as they are dependent upon subsequent decisions as to location, size of installation, size of staff, etc. The need for an identification service and the establishment of a permanent reference collection of insects and arthropods has been discussed by E. F. Knipling, in a memorandum to Dr. Matthew Drosdoff, former Administrator, International Agricultural Development Service, dated November 16, 1964 and by Judson U. McGuire, Jr. in McGuire and Crandall's 1967 "Survey of Insect Pests and Plant Diseases of Selected Food Crops of Mexico, Central America and Panama."

CONTACTS

Contacts made during the survey included the following persons (listed alphabetically by country:

Costa Rica

San Jose

William Schaffer, RDO, U. S. AID Mission
Russell Desrosiers, Asst. RDO, U. S. AID Mission
Byron Montgomery, Agricultural Attache, U. S. Embassy
Evaristo Morales M., Dept. Ent., Ministerio de Agricultura y Ganaderia
Alvaro Cordero, Dean, Facultad de Agronomia, Univ. Costa Rica
Barrio Miraflores Guadelupe, OIRSA
William E. Stone, OIRSA, Med Fly Project

Robert Rhodes, OIRSA, Med Fly Project
Ben Ami Peleg, OIRSA, Med Fly Project
Jorge Gutierrez Sanperio, OIRSA, Med Fly Project

Turrialba:
Leonce Bonnefil, Entomologist, IICA

El Salvador
San Salvador:
Carlos Meyor A., Director, OIRSA
Jack E. Lipes, Entomologist, FAO
Virgil E. Peterson, RDO, U. S. AID Mission
Raul H. Castro, Ambassador, U. S. Embassy
Eladio Izquierdo, Adm. Officer, U. S. Embassy
Richard S. Welton, Agricultural Attache, U. S. Embassy
Marco Tulio Cabezas, Jefe, Dept. Biol., Univ. El Salvador
Tomas A. Galarza Minaya, Dept. Biol., Univ. El Salvador
Enrique Vinatea Jaramillo, Dept. Biol., Univ. El Salvador

Santa Tecla:
Armando Alas Lopez, Sub-Director, Dir. Gen. Invest. Agron., Min. Agric.
Jose Enrique Mencia, Entomologist, Dir. Gen. Invest. Agron., Min. Agric.
Jose Arnoldo Trejo, Entomologist, Dir. Gen. Invest. Agron., Min. Agric.
Antonio Diaz Chavez, Entomologist, Dir. Gen. Invest. Agron., Min. Agric.
Claud Horn, Entomologist, USDA PASA

Guatemala
Guatemala City:
William H. Cowgill, ROCAP
Donald Fiester, RDO, U. S. AID Mission
Jorge Ibarra, Jefe, Museo Natural Historia
Jose Castro, Fac. Agronomia, Univ. de San Carlos
Carlos Henrique Fernandez, National Coffee Association

Honduras
Tegucigalpa:
Carrol Deyoe, RDO, U. S. AID Mission
Alberto Douglas Banegas, OIRSA, Sec. Invest. Torsalo
Oscar Banegas, Jefe, Dept. Sanid Vegetal, Min. Agric.
Fausto Rodriguez, Dept. Sanid Vegetal, Min. Agric
Rafael Mercado, Jefe, Sec. Antiacridido
Armando Valle, Director, Carrera Ciencias Agricolas, Univ. Nac. Automoma de Honduras
Salvador Quiroz B., Desarrural, Min. Agric.

El Zamorano:
Albert S. Muller, Director, Escuela Agricola Panamericana

Nicaragua

Managua:

Elton Ford, Asst. RDO, U. S. AID Mission
Armando Gonzalez, U. S. AID Mission
Francisco A. Estrada, Entomologist, Min. Agric.
Luis A. Telleria, Agronomist, Min. Agric.
Alvaro Sequeira, Entomologist, Min. Agric.
Ruben Boclan, Entomologist, Min. Agric.

Panama

Panama:

William B. Miller, Econ. Off., U. S. Embassy
Tom Stephens, RDO, U. S. AID Mission
Tom Reid, U. S. AID Mission
Ezequiel Espinosa, Director, Agric. Res., Min. Agric.
Rogelio Cuellar, Director, Veg. San. Dept., Min. Agric.
Alberto Perdomo, Plant Quar., Min. Agric.
G. B. Fairchild, Gorgas Memorial Lab.
Eustorgio Mendez, Gorgas Memorial Lab.

BASIC REQUIREMENTS

In order to support research in systematic entomology and/or provide an identification service, three basic elements are required. They are:

1. A good collection. The specimens should be in good condition, they should be accurately identified and properly prepared and labeled. If systematic research is to be conducted, large series of each species would be required so that variation within the species could be studied, and so that ecological and geographic distribution might be determined.

2. An adequate library. Taxonomic research requires that all literature pertaining to a group under study be available. A library containing references only to species described from, or known to occur in, the area of concern would not be sufficient. Even identifiers would need to have available literature pertaining to pest species in other areas that attack hosts (or relatives) occurring in the area of concern in the event any of such species might be introduced to the area or intercepted by quarantine inspectors.

3. Competent taxonomists and/or identifiers. The quality of research produced and the accuracy of identifications may be influenced by the competency of the investigator or identifier as well as by the inadequacy of the collection or library.

There are in Central America and Panama a number of small collections of a general nature and a few reference collections of economic species. The general collections are composed largely of butterflies. Those at the universities of El Salvador and Costa Rica are essentially newly organized and will be utilized in the proposed expanded programs for instruction in entomology. The reference collections vary in size, condition and usefulness. None are sufficiently complete to serve as the reference collection for the proposed Inter-American Insect Identification project. The collection of the Ministry of Agriculture of Nicaragua is the largest and contains many species identified by specialists of the U. S. Department of Agriculture's Insect Identification and Parasite Introduction Research Branch. There are in Central America and Panama a number of good agriculture libraries, but nearly all are inadequate for entomological research of a taxonomic nature. Exceptions might be the Gorgas Memorial Laboratory (insects attacking man and animals) and small specialized libraries of the very few taxonomists located in the area. It is thus obvious that the problems of establishment of a project as originally proposed would be immense. Some concept of the nature of the problems may be gained by consideration of the preceding facts and consultation of an article by Curtis W. Sabrosky, 1965, Pacific Insects, pp. 14-20, entitled "The Objectives of a Museum Entomology Department". This article is actually a talk given at the dedication of a new building of the Bernice P. Bishop Museum, but many of the problems discussed related to the proposal presently being considered. (See Appendix I)

It is difficult to make the practical recommendations for the implementation of the proposal as requested in the absence of a knowledge of what is possible financially. Accordingly, the following is considered to be minimal for the need that exists.

RECOMMENDATIONS

It is recommended that the following actions be taken:

1. The compilation of a list of the economically important insects and arthropods of Central America and Panama and a list of pest species of other areas that might be of potential importance.

2. Development of a reference collection of the listed economic species and the gradual accumulation of a synoptic collection of the other species of the area.

3. Assemblage through various ways of the pertinent literature for the economically important species.

4. Recruitment and training of a small number of identifiers and supporting staff.

5. After fulfillment of the above recommendations, to establish a centrally located insect identification service for Central America and Panama.

6. Finally, to encourage, develop and support increased entomological education in general and taxonomic training in particular.

LISTS OF ECONOMICALLY IMPORTANT INSECTS AND ARTHROPODS

The preparation of such lists would seem to be a primary prerequisite to the establishment of an insect identification unit. Otherwise, it will not be possible to assemble a reference collection nor to effectively train identifiers. At least part of the necessary reference literature can be assembled at the same time that the lists are prepared. The list of insect pests of selected food crops of Mexico, Central America and Panama prepared by McGuire is an excellent starting point; however, some species of insects attacking the crops covered were overlooked or omitted. In addition, the pests of other food crops, non-food crops (forage, forest, landscape plants, etc.) and insects attacking man and animals need to be included in the lists. A list of foreign pest species known to attack hosts (or close relatives) occurring in Central America and Panama should also be prepared.

DEVELOPMENT OF COLLECTIONS

It is recommended that two types of collections be established: A reference collection of the economic species and a synoptic collection of the other species of insects and arthropods. The two collections would in reality eventually form a single reference collection, but the two terms, reference collection and synoptic collection, are used to indicate a difference in the numbers of specimens of each species to be assembled in each instance and also to indicate a difference of priority of formation of the two collections. The reference collection of economically important species should be assembled first, and as soon as possible. The series of specimens of each species should be sufficient to cover the range of variation and to represent the geographic distribution in the area. All stages, eggs, immatures, pupae (when present) and adults should be represented. Material could be obtained through several sources. Freshly collected and reared specimens could be requested of entomologists and others working on different crops in each of the involved countries. Additional material could be obtained from other sources by request, exchange, etc. Dr. Karl Krombein, Chairman of the Department of Entomology, Smithsonian Institution, has indicated that identified duplicate material not otherwise available might be obtained from the U. S. National Museum Collections in exchange for material from Central America that would subsequently become available to the Center.

The synoptic collection of species not of known economic importance could be built up gradually as identified material became available. The attempted formation of a general, permanent, research collection of the insects and arthropods of Central America and Panama is not recommended. It is true that additional research material is desirable, but the attempted formation of another research collection is not the only way and certainly not the practical way to make such material available.

The layman does not generally realize the tremendous number of species that occur in the area. A very large number of insect cabinets, drawers, unit trays, museum space, preparators and collectors would be required to house and to form such a research collection. It would require, for example approximately 1500 to 2000 drawers for an adequate research collection of the butterflies and skippers alone. That number of drawers would require 70 to 90 cabinets (22 drawer capacity). The storage equipment alone would cost approximately $20,000 to $26,000 (based on U.S.N.M. costs for cabinets, $65.00, and drawers, $10.00 each, etc.). Ninety insect cabinets and access to them would occupy about 300 to 450 square feet of floor space according to whether they were stacked two or three cabinets high.

This example may present some insight into the costs and space requirements for a general research collection. But to pursue research in taxonomy collections of insects from other areas would also be necessary. Similarly, the same is true for the literature. The costs of assembling or reproducing a general taxonomic research library would be very great. It would be difficult to estimate what the cost might be. From these comments, it may appear that taxonomic research in the area is being discouraged. This is not the case. As taxonomists are trained and begin to undertake research, material could be assembled (collected, exchanged, and borrowed) and specialized libraries developed for the group of insects or arthropods being studied. Such research would not be discouraged but would remain a secondary activity of the taxonomists, whose primary function would be serv indentification. Such research would be supported only when directly related to an economic problem important to the area. A synoptic collection would consist of only a few identified specimens of each species.

If an identification unit is created, a policy should be established whereby material submitted for identification would either be retained for the collection or discarded in normal circumstances. Such a policy would eliminate the costs involved in packing and shipping returned material, and would not inconvenience the senders who would normally retain examples from lots sent to the Center.

There are several ways by which identified material could be obtained for the collection. They need not be discussed here as any qualified person responsible for the formation of such a collection would be aware o the different methods. It would be appropriate to emphasize one technique. The best way to build the synoptic collection and benefit taxonomic research on species of the area would be by providing collecting opportunities to taxonomists and students of taxonomy. They know best when, where, and how to collect the insects they study. Material collected would represent more species and would be properly prepared.

A program of support that might provide housing, subsistance, transportation, use of facilities of field stations, experiment stations and fruit company installations or any combination of such aid if announced in the Newsletter of the Association for Tropical Biology or other such publications would undoubtedly attract many interested persons. Perhaps such a program might be supported, at least in part, by granting agencies, foundations or institutions if approached by OIRSA.

If a collecting program is organized, a few stipulations regarding disposition of the material would be in order. One requirement would be that a few identified specimens of each species be returned for the synoptic collection. A moderate series of each species and all holotypes of any newly described species should be deposited in major museums. Types should preferably be deposited in that museum housing the largest number of types of the group of insects being studied.

EQUIPMENT AND SUPPLIES

Minimum equipment, furniture, supplies, etc. needed to establish and maintain a collection and to provide an identification service are listed below. Estimated costs or range of costs are given only for major items, and even in those cases the estimates are general. Actual costs in the Central American region may vary from one country to another.

Insect cabinets - Initially, about 50 would be needed (24 to house reference collection of economic species). A synoptic collection will probably require a total of 250 to 300 cabinets. These additional cabinets could be supplied at a fixed rate (15 or 20 per year) or as the need dictated. The cabinets are wood frame, sheet-metal covered. See reproductions of blueprints for type used in the U. S. National Museum in Apprendix III. Cost: $3,250.00 (based on U.S.N.M. cost, $65.00 each). A few cabinets for storage of specimens in vials and bottles of alcohol would be required. The cabinets are similarly constructed but are smaller and have permanent shelving to hold racks of vials and bottles. The cost of construction is slightly more than for regular cabinets. No plans are submitted for these, but any kind would be satisfactory provided the over-all dimensions and spacing of the shelves were carefully planned according to the kind of racks, vials and bottles used. Cost: Approximately $500.00

Insect drawers - 1100 should be provided initially. Costs $11,000.00 (@ $10.00 per drawer). Plans are included for the type of drawer used in the U.S.N.M. The drawers are glass-topped and have a space in each of the four sides for napthaline flakes (a deterent to the invasion by museum pests). The number of drawers required is based on 50 cabinets (22 drawers per cabinet).

Napthaline flakes - 600 pounds. A 100 lb. drum will fill about 200 drawers. Costs $106.40 (@ $17.40 per drum).

Unit trays - These are small cardboard trays covered with white paper. A pinning bottom is placed in these and the insects pinned therein. Unit trays greatly enhance the appearance of the collection, but the real value is that they permit the rapid reorganization and expansion of the collections with a very minimum risk to the specimens being preserved. They are made in column widths (4 columns to a drawer) i.e. 1/2 column, 1/4 column, 1/8 column, 1/12 column, etc. The actual dimensions vary according to the type of insect drawer being used. Those given are for the U.S.N.M. drawer. The prices indicated are for lots of 5000. They may be obtained from Drug Package Inc., O'Fallon Missouri, 63366. At the start, it is recommended that the following sizes and numbers be purchased:

1/2 column (7 7/8" x 3 15/16" x 1 3/8")	- 5000 -	$ 344.24
1/4 column (3 7/8" x 3 15/16" x 1 3/8")	- 5000 -	213.98
1/8 column (1 13/16"x 3 15/16" x 1 3/8")	- 10000 -	400.00 approx
1/12 column (1 1/4" x 3 15/16" x 1 3/8")	- 15000 -	502.23
		$1460.45

Pinning bottoms for unit trays - Sheet cork or other materials can be used, but they are expensive and not as satisfactory as a type of polyethylene foam. This material comes in planks 35" x 16" x 1/4" (gau The cost is $.4641 (less than 1/2 dollar) per plank. An initial purchase of 500 planks ($232.05) is recommended. The material may be purchased from Barnel Foam Products Co., Inc., P. O. Box 655, Buffalo, New York 14240. Instructions on the method of cutting and gluing could be obtained by writing to the Dept. of Entomology, U. S. National Museum, Washington, D. C. 20560. Certain glues must be used. The amounts and costs have not been indicated in this report.

Insect pins - The number of pins required will depend upon the extent to which an effort is made to build up the synoptic collection, or the number of specimens collected. Pins may be purchased from Emil Arlt, P. O. Box 37, Premlechnergasse 28, Wien XII/87, Austria. These are stainless steel with plastic heads, but the type should be indicated t ordering. Purchase of the following numbers and sizes is recommended: Size 0 - 10,000; Size 1 - 20,000; Size 2 - 40,000; Size 3 - 30,000; Size 4 - 10,000; Size 5 - 5,000. At $2.30/1000, the cost is $264.50.

Minutens and polyporus for double mounts - These are available from Watkins and Doncaster, 110 Park View Rd., Welling, Kent, England. About 10,000 minutens and 8 oz. of polyporus strips will be needed initially, for a total cost of about $40.00. (Minutens - 2.80/1000; polyporus - 3 shillings per 1/4 oz).

Slide boxes - 100. Cost will be about $150.00 to $200.00.

Work tables - 6 (white formica tops) - These probably could be constructed locally. They should be 25" wide, 6 or 7 feet long and 30" high. They should be provided with one or two 18" drawers for small dissecting tools, etc. Cost is estimated at $550.00.

Desks - At least 4 is required, but 10 is recommended so that each identifier may be supplied with one. Estimated cost: $500.00 to $1250.00.

Chairs - At least 20 (various types). Estimated cost: $1000.00.

Microscopes - 11 (7 binocular dissecting microscopes and 4 compound microscopes). The total cost will depend upon the quality, number and magnifications of objectives, oculars, etc. Prices will probably vary from $600.00 to $2500.00 each. It is recommended that the best equipment to meet the need be acquired. Total estimated cost for 11: $10,000 to $12,000.

Microscope lights - 8 (1 compound type for use with best compound microscope, 7 barrel types for use with the other microscopes). Estimated cost is about $700.00.

Typewriters - 8 (2 electric, 6 standard). Estimated cost: $1800 to $2000.

Bookcases - 7. Estimated cost: $750.

Storage cabinets - Upright steel - 5 (1 for regular collection of microslides). Estimated cost: $350.

Letter files (4 drawer) - 18 (2 each for identifiers for filing reprints, etc., 6 for administrative needs). Estimated cost: $1650.

Card files (3x5) - 4 10 (double) drawer and 10 2-or 4-drawer units. Estimated cost: $600.

Insect boxes (economy redwood type) - 1 gross. Estimated cost: $450.

Drying oven (for microslides, etc.) - 1. Estimated cost: $360.

Refrigerator - 1. Estimated cost: $250.

Miscellaneous laboratory equipment and supplies - No attempt will be made to list all of the necessary items. The items needed for collecting, preparation, identification, maintaining the collection, etc., could be determined later when policy is decided and the scope of the operation is determined. Such items would include small tools (forceps, scissors, etc.), spreading boards, slide labels, locality labels, glass and plastic wares, hot plates, chemicals, reagents, stains, microslides, coverslips, bulbs for microscope lights, etc. Ordinary office supplies are not included, but fairly large numbers of 3x5 cards and manila folders should be included. Estimated cost: $4,000.

Miscellaneous furniture not specifically listed (tables, paper cutter, other office equipment, etc.). Estimated cost: $1500.

Vehicles - At least one for various administrative needs. One or more additional vehicles will be necessary if any collecting is to be attempted to build up the collection. The cost per vehicle will depend on country from which purchased, number, make, year, model, fuel allowance, repairs and maintenance, etc. Estimated cost: $5000 to $15,00

PERTINENT LITERATURE TO AID IDENTIFICATIONS

The necessary literature required for an identification service could be assembled through gifts of available duplicate reprints, outright purchase, or by duplicating (xeroxing, etc.) papers and works otherwise not available. It is extremely difficult to recommend an amount of money to be made available for this purpose. After the lists of economically important species are compiled, a study will be required to determine what literature is needed. It is suggested that at least $5,000 be initially provided, one-half for purchases and one-half for duplicating costs.

STAFF, RECRUITING AND TRAINING

The following recommendations are based on the minimum need, assuming competent personnel are obtained for the assignments as projected. No salary estimates for the individual positions are made as these can better be determined by persons more familiar with local salaries and salary structure in the area. The salaries should be sufficient, however, to attract qualified individuals and to compete with salaries of the universities and private industry.

Administrator-Curator - Qualifications: Ph.D. in Entomology, preferably in taxonomy or with museum experience and possessing administrative ability. Duties: To organize, to administer identification unit and to act as head curator. If a taxonomist is employed it should be emphasized that there would be little or no opportunity for research on an official basis.

Secretary - Usual qualifications and duties.

Typist - Usual qualifications. Duties would include typing lists, cards, identification reports and letters when necessary.

Clerk-Administrative Assistant - Qualifications: Bachelor degree in Entomology. Duties: Maintain identification records, handle and assign material for identification, maintain supplies, etc.

6 Identifiers-Curators - Qualifications: Masters degree or equivalent experience. They should have had courses in external and internal morphology, systematics, bibliographic techniques, etc. In addition, it would be helpful if they had an interest and previous experience with the group or a group of the insects which they would be identifying. Duties: To identify insects of certain groups and to help organize and maintain the reference and synoptic collections.

An examination of the list of species attacking certain food crops (McGuire, 1967) reveals that 86 percent (697 of 810 species) are Coleoptera (beetles), Lepidoptera (moths & butterflies) or Hemiptera-Homoptera (true bugs, leafhoppers, etc.). Therefore, it is recommended that an identifier be obtained for each of the three groups. The remaining groups of insects and arthropods could be covered by three other identifiers. The actual assignments would have to be made after the lists of economic species have been completed. Possible assignments might be: (1) Orthopteroids, neuropteroids, etc. (2) Diptera-Hymenoptera, etc. (3) Collembola, myriapods, mites, etc. The Gorgas Memorial Laboratory probably would continue to provide identifications of insects and arthropods attacking man and animals.

If additional formal training is required in order to secure qualified identifiers for some groups, it is recommended that the necessary additional training be received at an institution such as the Department of

Entomology, Universidad Central de Venezuela, Maracay, Aragua, Venezuela. In such institution, the trainee could receive the necessary instruction in his own language and work with a fauna very similar to that of Central America and Panama. If qualified personnel are not immediately available, some consideration might be given to the employment of foreign nationals, at least on a temporary basis. Emphasis should be placed on the fact that the individuals are to identify insects and arthropods and not to attempt taxonomic research. If a good identification service is to be provided, the minimum staff and resulting assignments will of necessity eliminate the possibility of time being available for taxonomic research. If it should subsequently be decided that certain taxonomic research be developed, taxonomists should be employed for that purpose only.

After identifiers have been employed, it is recommended that they be afforded the opportunity to study for 3 to 6 months in Washington with specialists on insect identification in the U. S. Department of Agriculture and in the Smithsonian Institution. This time could be spent studying characters used to identify pest species, assembling pertinent literature and possibly obtaining some specimens. The cost would depend on the length of stay, per diem rate, number sent, etc. Estimated cost: $10,000 to $25,000.

2 Preparator-technicians - Qualifications: This type of technician can be easily trained. An interest in this type of work and in biology in general would be helpful, but dexterity of the hands and a patient nature are more important attributes. Duties: To prepare specimens for the collection (pin, label, spread, etc.), napthalene drawers, etc.

Collector - In order to build up the collection as rapidly as possible, it would seem desirable to employ one or more entomologists for that purpose. The number, of course, would depend upon what is possible, the support given to collecting by taxonomists from other areas and the goal set for assembling the total synoptic collection.

Custodian - Funds for custodial service and supplies would be necessary.

ESTABLISHMENT OF AN IDENTIFICATION SERVICE AND LOCATION OF THE UNIT

Recommendations were requested for an operating procedure for identification service and for a possible geographic location. The former may be obtained from Dr. R. I. Sailer, Chief, Insect Identification and Parasite Introduction Research Branch, A.R.S., U. S. Department of Agriculture, Beltsville, Maryland. A modified procedure could then be developed.

Recommendation as to location would depend on whether one of the participating countries is expected to furnish the building. A number of possible sites and some buildings were examined; none of the buildings examined would be satisfactory. Climatic and other factors were also considered during the survey. The unit should be centrally located and near good air transportation to insure rapid receipt of material and reporting of indentifications. The capitols of any of the four centrally located countries would satisfy those requirements, but Tegucigalpa, Honduras would provide better climatic conditions. Humidity control and air conditioning needs for protection of the collection from mold would not be as serious a problem in Tegucigalpa as would be the case at the other three locations. Volcanic activity in Honduras would not likely constitute a threat to the preservation of the collection. In addition, building costs and possible available sites in Tegucigalpa would appear to favor that location.

Obviously it will be necessary to lease, purchase or construct a suitable building. Construction of a building designed to suit the needs of the Center is recommended. A leased building might require a subsequent move that would constitute a hazard to the preservation of the collection. Purchase of an existing building might easily require costly modifications that could cause the total cost to exceed new construction costs. Average construction costs in Tegucigalpa were found to be approximately 130 lempiras sq. meter. (Two lempiras equal one U.S. dollar.) At that rate an adequate building could probably be constructed for about $20,000 to $25,000. The building would require a minimum of 12 offices (4 for administrative personne 6 for identifiers, 1 for preparators and 1 for visitors and/or collectors), a storeroom, restroom(s) and a room or space approximately 65 feet by 23 feet for the synoptic collection. The office size for the identifiers should be at least 14 x 18 feet to enable housing up to 8 insect cabinets for the reference collection in a room. The space requirement for the synoptic collection is based on 240 insect cabinets arranged 2 high. With a minumum ceiling height of 8 feet, a third tier of 120 more cabinets could be added if necessary. During the years while the collection is being developed, part of the space could be used for temporary storage, etc. The total number of cabinets recommended may seem large, but more than 200 cabinets are required to house the four families of moths in one assignment at the U. S. National Museum. These are research collections and represent the world fauna. A sketch showing a possible arrangement of cabinets is in Appendix III. Fluorescent lighting in the ceiling over the aisles between rows of cabinets is suggested. Even in Tegucigalpa, it would be desirable to provide some humidity control in the building, and especially so in the collection room or space.

McGuire, 1967 recommended that a collection be developed and suggested that the Escuela Agricola Panamericana at El Zamorano, Honduras be selected as the site. Location at that institution would have the disadvantages of a higher humidity, greater distance from airport and other faciliti and a lack of housing for the staff. He also suggested that the collection could be utilized as a teaching aid and that the curator could instruct courses in entomology. There would be no objections to the latter, and such action could be beneficial to the trainees at that institution, but it is not recommended that the collection should be used as a teaching aid. Such use would be too detrimental to the specimens being preserved. Certainly the existance of a named collection would simplify the formation of adequate teaching collections, but it need not be located at an education institution and it is not recommended that the suggested use as a teaching aid should be a consideration in the determination of the location of the collection. On the other hand, location of the identification unit and collection at or near an educational institution might offer certain advantages. Financial support, availability of existing generalized libraries and the possibility of part-time student employment in collecting and as preparators, etc. might well be important considerations.

SUPPORT OF INCREASED ENTOMOLOGICAL EDUCATION

It is recommended that increased emtomological education in general, and taxonomic training in particular, be supported, encouraged and developed through whatever methods are possible. The many benefits of such a program scarcely need to be discussed as they are so obvious. The subsequent production of more and better qualified potential identifiers and researchers would be sufficient reason for support and development. The authorities of three of the educational institutions visited during this survey indicated that plans are already being developed to increase the number of entomological courses being taught. Even so, it is unlikely, in the absence of research collections and taxonomic libraries, that any of these institutions will be able to offer advanced training and degrees in taxonomy in the very near future. The expansion of the teaching program does offer the possibility of teaching positions for taxonomists. It is hoped that eventually research positions might also be developed and supported.

W. H. Anderson

APPENDIX E-3

NOV 20 1964

November 16, 1964

To: M. Drosdoff, Administrator, International Agricultural Development Service

Through: B. T. Shaw, Administrator, ARS

H. A. Rodenhiser, Deputy Administrator Farm Research, ARS

From: E. F. Knipling, Director, Entomology Research Division

Subject: Inter-American Insect Identification Project

Transmitted herewith is a proposal for an Inter-American Insect Identification Project for your consideration and appropriate action.

Enclosure

cc: B. T. Shaw
H. A. Rodenhiser
P. Oman
W. H. Anderson

INTER-AMERICAN INSECT IDENTIFICATION PROJECT

THE PROBLEM: The numerous small Central American countries, having limited technical talent trained in entomology, and with limited resources, are unable individually to assemble the technical talent necessary to implement modern agricultural methods. A particular problem relates to the identification of insects. Whereas the use of broad spectrum insecticides for the solution of insect pest problems only infrequently required exact identification of pests, the increasing attention now being given to other insect control methods will inevitably increase the need for accurate information as to the pest or pests involved. The operation of an efficient plant quarantine service is likewise dependent upon adequate support from insect taxonomy.

For the past 25 years or more, the U. S. Department of Agriculture's Insect Identification Unit has assisted many of these countries in their identification problems. This assistance involves several thousands of identifications annually. Unfortunately, due to a relatively limited knowledge of the insect fauna of Middle America, and the tremendous service load from other sources that is placed on the Department's Insect Identification Unit, the identification service rendered the Central American countries has been considerably less than adequate to meet their needs. There is urgent need for an intensive and coordinated effort directed at increasing our knowledge of the insect fauna of the Middle Americas, with particular reference to those species that are pests of agricultural products, pests of man and animals, or vectors of disease.

OBJECTIVE: The objective of the Inter-American Insect Identification Project is to develop, in the Middle American countries, tebhnical competence needed for research to improve and extend our knowledge of the insect fauna of the region and provide a practical method of making service identifications of insects as needed by the countries comprising the region.

PROPOSAL: It is proposed that the International Agricultural Development Service request the United States Agency for International Development to support a training program in insect taxonomy for Latin American entomologists in order to provide the corps of trained personnel required for a concerted attack on the problem outlined above. A further part of the basic plan is the establishment and development, within a period of 5 to 10 years, of an international reference collection of insects and a taxonomic unit centrally located in the Middle Americas that could assume responsibility for research in systematic entomology, provide an identification service, and render advice on matters requiring competence in this field. It is our view that no single country in the Middle American region is in a position to develop and maintain adequate reference collections and support a toxonomic staff that would be competent to meet all the needs that might arise. However, if the necessary cooperation between Middle American countries can be accomplished, we believe it is entirely possible that by pooling their resources, the cooperating countries can solve their problems in this technically complex field. With that objective in mind, it would be a part of the proposal to endeavor to find a suitable (preferably international) organization in the Middle Americas that might appropriately serve as the sponsor for an Inter-American project of this sort. The Organismo International Regional de Sanidad Agropecuaria (OIRSA) and the Inter-American Institute of Agricultural Sciences should be considered in this connection.

It is proposed that the implementation of the project would be under the technical guidance and coordination of the Entomology Research Division of the Agricultural Research Service, U. S. Department of Agriculture.

If the above proposal appears to be acceptable in principle, we shall be glad to elaborate further on the need for the project and details of how it might be implemented.

APPENDIX F

Dictan normas para incrementar la producción agraria del país

DECRETO LEY Nº 23056

EL PRESIDENTE DE LA REPUBLICA

POR CUANTO:

El Gobierno Revolucionario ha dado el Decreto-Ley siguiente:

EL GOBIERNO REVOLUCIONARIO.

CONSIDERANDO:

Que es objetivo del Gobierno incrementar la producción y productividad agraria del país;

Que, para tal efecto, es conveniente dictar normas complementarias que posibiliten la realización de acciones de investigación, extensión y fomento agrario, en forma ágil, oportuna y coordinada;

En uso de las facultades de que está investido; y,

Con el voto aprobatorio del Consejo de Ministros;

Ha dado el Decreto Ley siguiente:

Artículo 1º — Incorpórase como Organos Ejecutivos del Instituto Nacional de Investigación Agraria — INIA, el Servicio Nacional de Maquinaria Agrícola (SENAMA) Gerencia Operativa de la Empresa Pública de Servicios Agropecuarios en Liquidación y el Centro de Investigación y Capacitación para la Reforma Agraria; como órgano de apoyo la Oficina General de Comunicación Técnica del Ministerio de Agricultura y Alimentación; y como órgano de línea la Dirección de Extensión de la Dirección General de Agricultura y Crianzas del Ministerio de Agricultura y Alimentación.

Artículo 2º — Adiciónase al artículo 5º del Decreto Ley 22431 el párrafo siguiente: "Así como la extensión y fomento agrario".

Artículo 3º — Adiciónase al artículo 13º del Decreto Ley 22431 el inciso siguiente: "f) Los provenientes de remates de activos fijos dados de baja".

Artículo 4º — Será de aplicación al Servicio Nacional de Maquinaria Agrícola SENAMA la Primera y Segunda Disposiciones Especiales del Decreto Ley 22431, así como lo dispuesto en el artículo 45º del Decreto Ley 22744.

Artículo 5º — Los trabajadores empleados de los órganos a que se refiere el artículo 1º del presente Decreto Ley mantendrán su régimen laboral y de seguridad social.

Artículo 6º — Derógase, modifícase o déjase en suspenso, en su caso, las disposiciones que se opongan al presente Decreto Ley.

Dado en la Casa de Gobierno, en Lima, a los veintiún días del mes de Mayo de mil novecientos ochenta.

General de División EP FRANCISCO MORALES BERMUDEZ CERRUTTI, Presidente de la República.

General de División E.P. PEDRO RICHTER PRADA, Presidente del Consejo de Ministros y Ministro de Guerra.

Teniente General FAP LUIS ARIAS GRAZIANI, Ministro de Aeronáutica.

Vicealmirante AP JUAN EGUSQUIZA BABILONIA, Ministro de Marina.

Embajador ARTURO GARCIA Y GARCIA, Ministro de Relaciones Exteriores.

Doctor JAVIER SILVA RUETE, Ministro de Economía y Finanzas.

General de División EP JOSE GUABLOCHE RODRIGUEZ, Ministro de Educación.

Vicealmirante AP JORGE DU BOIS GERVASI, Ministro de Industria, Comercio, Turismo e Integración.

General de División EP RENE BALAREZO VALLEBUONA, Ministro de Energía y Minas.

General de División EP JOSE SORIANO MORGAN, Ministro de Transportes y Comunicaciones.

Teniente General FAP, EDUARDO RIVASPLATA HURTADO, Ministro de Salud.

Teniente General FAP JAVIER ELIAS VARGAS, Ministro de Trabajo.

General de Brigada EP CESAR ROSAS CRESTO, Ministro de Vivienda y Construcción.

Contralmirante AP JORGE VILLALOBOS URQUIAGA, Ministro de Pesquería.

General de Brigada EP CESAR IGLESIAS BARRON, Ministro del Interior.

General de Brigada EP CARLOS GAMARRA PEREZ EGAÑA, Ministro de Agricultura y Alimentación.

POR TANTO:

Mando se publique y cumpla.

Lima, 21 de Mayo de 1980.

General de División E.P., FRANCISCO MORALES BERMUDEZ CERRUTTI.

General de División E.P., PEDRO RICHTER PRADA.

Teniente General FAP, LUIS ARIAS GRAZIANI.

Vicealmirante AP., JUAN EGUSQUIZA BABILONIA.

General de Brigada E.P., CARLOS GAMARRA PEREZ EGAÑA.

LA MOLINA
LIMA - PERU

PROYECT PROPOSAL

TITLE: Regional Training and Research Center on Integrated Pest Management at Universidad Nacional Agraria, La Molina, Lima-Peru.

Brief Summary

Crop protection is broadly recognized as a very important factor in crop production, particularly in developing countries. If losses due to pests, diseases and weeds are to be reduced, the protection practices must be improved. This includes a change in philosophy, from reliance on insecticides to a balanced ecological approach. That is the adoption of the Integrated Pest Management Systems. The implementation of I.P.M. at the farmer level, under the ecological, technological, economic and social conditions that characterize the agriculture in developing countries, requires appropiate training and research developed under those conditions. The project pursues to establish a training and Research Center at Universidad Nacional Agraria, La Molina (Lima-Perú), in order to improve the crop protection capabilities of Latin American countries, through formal and informal training on I.P.M. Likewise, to develop I.P.M. pilot programs for some of the main crops of the area (corn, cotton, rice, potatoes, beans sugarcane, citrus and other fruits) to demonstrate the feasibility of such programs and to gain experience about them.

Justification for a training and Research Center on I.P.M. in La Molina, Lima-Peru

The need to protect crops against pests, diseases, nematodes and weeds in Latin America is increasing as it is the need to produce more food and fiber for an ever increasing population. It is well documented that the unilateral control of pests based on chemical treatments has resulted in most instances in resistant strains of pests, the appearance of new pests, residue problems, environmental contamination and very high costs usually beyond the reach of medium and small farmers. The only solution is to shift the philosophy of crop protection to a balanced ecological approach: The Integrated Pest Management System.

The practical implementation of I.P.M. at the field level as well as the establishment of the pilot programs of I.P.M. for the main crops of each country require lots of well trained personnel which unfortunately are lacking at the present time in Latin America. Training of this kind within the region has many advantages: it is offered in a common language (which means that it is opened to more people), main crops and pests are largely common; general technology, ecological conditions, sociological and economic problems are also similar to most of the countries; and at the same time are different in all these respects from those of developed countries. The new developments in I.P.M. that take place in developed countries will also be present in the training programs through visiting professors. This approach does not discard the training at developed countries: on the contrary it considers that this should be given to well selected people with the capacity to digest the knowledge obtained abroad and the qualities to become researchers and instructors in their own countries.

Peru, as a country, and the Universidad Nacional Agraria, as an Institution of post graduate training, have a good qualifications to become a Center for training and Research on I.P.M.

Peru has most of the climates that occur in the world; from the dry dessert of the coast to the hot humid tropic of the Amazonian jungles. The high Andean Mountains in between forms all kind of temperate climates. These unique characteristics make possible to grow all kind of crops present in all Latin America: corn, rice, wheat, potatoes, beans, sugar-cane, cotton, dĕciduos fruits, tropical and subtropical fruits, etc. The various levels of agricultural technology are also present: agriculture under irrigation and under rainfall; relatively high mechanization and lack of it; large, medium and small land units, and other characteristics.

With respect to I.P.M. experience, in Peru there is a well recognized cotton ecosystem management that has been in practice for many years. As a result the Central Coast cotton growers average two to three sprays per season (mainly inorganic insecticides) as compared to 20-30 or more sprays in other cotton growing areas.

The Universidad Nacional Agraria, La Molina, Lima, Peru has the basic teaching facilities required for the proposed training. At the present time this institution offers degrees ón Entomology and Plant Pathology at Master level (see Appendix 1). The staff at these fields is fairly well trained (see Appendix 2). The headquarters of the university is in La Molina, Lima, but it also has areas of research and production in Cañete (Coastal area), Jauja (high Andean area), and San Ramon-Satipo (jungle).

Objectives of the Project

The main objective of the project is to establish a Center for Training and Research on I.P.M. for Latin America (or for the countries of the Andean Region) at the Universidad Nacional Agraria, La Molina, Lima, Peru. More specific objetives of this Cetner are:

1. Provide formal training at the M.S. level on I.P.M. for Ingenieros Agronomos and other profesionals from Latin America (Andean Region).
2. Provide informal training in the form of short courses, work shops, and seminars on I.P.M. for the Region.
3. Establish I.P.M. research Pilot Programs on some selected crops as a demonstration of the feasibility of such system, and to investigate the practical implementation of new developments.

Location and Duration of the Project

The Center of training and Research on I.P.M. will be headquarted at Universidad Nacional Agraria, La Molina, Lima, Peru.
The duration considered is a 5 year period, that can be renewed.

Contributions of the Universidad Nacional Agraria, La Molina

The U.N.A. will provide basic laboratory and classroom facilities, some basic equipment and teaching materials; access to its teaching collections, agricultural fields in the Coast, Sierra (interandean area) and upper jungle; part-time instructors and researchers; the experience and problems of the region.

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BUDGET

	1rst.year U.S. Dollars	
I - Training Base budget		
A.-Personnel		
Project Coordinator (1/2)*	12,000	
National Instructors (1/4)*(8)**	24,000	
Administrative Support	10,000	
Local technicians and labor	5,000	
Visiting Instructors (Researchers) (1/2)*(2)**	40,000	
		91,000
B.-Travel		
Local Instructors	5,000	
Visiting Instructors	10,000	
Local field trips	20,000	
		35,000
C.-Equipment & Supplies	100,000	
		100,000
Sub-Total:		226,000
II - Research Budget		
A.-Personnel		
Project Coordinator (1/2)*	12,000	
National Research Associates (1/2)* (4)**	24,000	
Administrative support	10,000	
Local Technicians & labor	10,000	
Visiting Instructors (Researchers) (1/2)*(2)**	40,000	
		96,000
B.-Travel		
Local Researchers	15,000	
Visiting Researchers(Instructors)	10,000	
		25,000

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C.-Equipment & Supplies	50,000	
		50,000
Sub-total		171,000

III - Trainee Budget

Subsistance for M.S. trainee at M.S. ($12/day) (20)**	72,000	
Subsistance short course trainee (2 short courses)(20)** (20 days)	9,600	
Travel ------------------------------------	16,000	
Sub-Total:		97,600
Total:		494,600
		(U.S.Dollars)

* part-time
** number of persons

Courses related to Plant Protection offered by the Universidad Nacional Agraria within the curricula of Magister Scientiae in Entomology and in Plant Pathology.

Entomology:	General Entomology Principles of Pest Control Agricultural Entomology Rearing and Insect population Assessment Insect Morphology (g) Insect Systematics I (g) Insect Systematics II (g) Insect Anatomy and Physiology (g) Medical and Veterinary Entomology (g) Pesticide Management and Toxicology(g) Insect Ecology (g) Integrated Pest Control (g)
Plant Pathology:	General Plant Pathology Agriculture Plant Pathology Diseases of Industrial and Food Crops Diseases of Horticultural Crops Forest Pathology Micology Control of Plant Diseases Phytopathological Techniques (g) Advanced Plant Pathology (g) Phisiology of Parasitism (g) Plant Pathogenic Bacteria (g) Plant Pathogenic Virus (g) Plant Pathogenic Fungi (g)
Nematology:	General Nematology Plant Parasitic Nematodes
Weed Science:	Weed Control

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Staff of the Universidad Nacional Agraria related to Plant Protection courses and/or research.

Fausto H. Cisneros	--- Ph.D., Entomology.
Klaus Raven	--- Ph.D., Entomology.
William E. Dale	--- Ph.D., Entomology.
Teresa Ames	--- Ph.D., Plant Pathology.
Enrique Fernández	--- Ph.D., Plant Pathology.
Salomón Helfgott	--- Ph.D., Weed Science.
Carlos López	--- Ph.D., Ecology.
César Fribourg	--- M.Sc. Plant Pathology.
Ricardo Mont	--- M.Sc. Plant Pathology.
Manuel Canto	--- M.Sc. Nematology*.
Jaime Castillo	--- M.Sc. Plant Pathology.
Mario Zapata	--- M.Sc. Entomology.
Juan Herrera	--- M.Sc. Entomology.
Jorge Sarmiento	--- M.Sc. Entomology.
Vicente Rázuri	--- M.Sc. Entomology.
Ulises García	--- M.Sc. Entomology.
Leonor Mattos	--- M.Sc. Plant Pathology.
Mónica Lázaro	--- M.Sc. Nematology.
Menandro Ortiz	--- Doctor in Biology.
Pedro Aguilar	--- Doctor in Biology.
Inés Redolfi	--- M.Sc. Entomology.
Isaías Combe	--- Ing. Agrónomo, Entomologist.

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* under a Ph.D. Program at Cornell.

APPENDIX H

FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum OF INTENTION

DATE: February 15, 1980

VISIT OF TITLE XII LAC REGIONAL WORK GROUP TEAM (RWG)

Dr. John T. Murdock, Chairman, LAC/RWG, and Representative of BIFAD/JCAD(Board for International Food and Agricultural Development/Joint Committee on Agricultural Development)

Dr. Darrell Fienup, Agricultural Economist, Michigan State University

Mr. C. Blair Allen, LAC/DR/RD Staff, AID/W

January 28, 1980 - Meeting at DNP

Dra. Nohora Bateman, Chief Technical Cooperation Division, DNP
Dr. Gabriel Montes, Chief Agrarian Studies Unit, DNP
Dr. Santiago Tobón, Director PAN
Dr. Dario Fajardo, Chief, Pilot Projects, PAN
Dr. Henry Arboleda, Acting Chief, División de Corporaciones DNP
Dr. Sergio Ardila, Technician , División de Corporaciones, DNP

AID:

Dr. David H. Schaer, Agricultural and Rural Development Officer
Mr. Marvin Cernik, Health, Nutrition and Population Officer
Mrs. Beatriz de Rodriguez, Training Advisor

The following were discussed and agreed upon in principle:

1. Mechanism to follow in implementing Title XII activities in Colombia

Dra. Bateman indicated that there is an on-going bilateral Agreement between the U.S. Government and the GOC signed in 1962. (Copies attached in English and Spanish). In the opinion of DNP this basic Agreement can serve as the enabling Agreement ("Convenio Marco") under which specific Title XII sub-projects or activity agreements can be developed between U.S. and Colombian institutions. DNP and AID do not anticipate problems in using this procedure for implementing Title XII activities after the AID Mission is closed.

2. The following three types of Title XII activities were presented by the RWG Team for consideration of DNP:

a) Research programs (CRSP's) especially those important to development in Colombia, including: human nutrition, sorghum, beans and cowpeas, tropical soils, aquaculture, small and large rumiants, were discussed. It is anticipated that Colombian institutions such as ICA and INDERENA will seek active participation in several of these programs.

b) Strengthening grants. There are 42 U.S. universities participating in Title XII activities which have received grants to strengthen their capabilities to work effectively in developing countries. Several of these universities have indicated an interest in working in Colombia.

Efforts will be made to match participating universities and Colombian interests in programs developed from strengthening grants.

c) Technical Assistance (activities normally carried out under bilateral AID programs). In Colombia, Title XII may serve as a communication channel for developing specific projects which would include collaborative assistance. Examples: subsistence farm studies plus statistics information systems and/or natural resource inventory/management, under PAN and Regional Corporation respectively.

The Team discussed the importance of establishing a mechanism to carry out programs which will maintain collaborative relationships between Title XII institutions and Colombian institutions of research, teaching and extension.

Emphasis was placed on the fact that it is especially important to establish collaborative procedures with the GOC quickly, since the AID Mission is phasing out.

The Team also emphasized the collaborative nature of these activities and the need for joint financial support. Details for financing specific activities must be determined when projects are developed. A general guide in the past has been that a minimum of 25% of the total budget must come from the host country. In accordance with previous meetings, the funds from previous two step AID loans to Colombia could be used for this counterpart contribution if agreed upon by USAID/C and DNP.

Dra. Bateman pointed out the importance of the training programs, and mentioned the difficulty in obtaining financing for these programs.

DNP stated that they would act as a coordination agency for Title XII activities in Colombia. The operational agencies would develop documents for Title XII activities in accordance with priority needs. It was also mentioned that programs could be implemented through universities (Universidad de Los Andes, Javeriana, Valle, etc.). through appropriate arrangements with CONCIENCIAS or a similar arrangement. This arrangement might be expecially useful in the case of activities of interest to PAN, since PAN is not an implementing institution. Several priorities for possible Title XII collaboration were suggested during this meeting. They include:

a) Improved statistical information and data needed for planning and policy decision.

b) Assistance for developing agro-industrial projects, food processing, etc.

c) Development of systems for monitoring nutritional deficiencies in subsistence level rural population groups.

d) Natural resources inventorying and watershed development.

e) Training

The Team suggested that it migh be useful for DNP Officials to come to the U.S. at an appropriate time to meet with BIFAD and to visit potential Title XII collaborators.

- Original in Spanish signed by:

DAVID H. SCHAER Chief, Agriculture and Rural Development Division - AID 2-6-80	NOHORA BATEMAN Chief, Technical Cooperation Division DNP	MARVIN CERNICK Chief, Health, Nutrition & Population AID

JERRY B. MARTIN
AID Representative

DOCUMENTO DE INTENCION

VISITA DEL EQUIPO REGIONAL DE TRABAJO, TITUTLO XII (RWG) :

Dr. John T. Murdock, Preside el Equipo Visitante.

Representante de BIFAD/JCAD (Junta Internacional para el Desarrollo de Alimentos y Agricultura/ Comité conjunto para el Desarrollo Agrícola.

Dr. Darrel Fienup, Economista Agrícola, Michigan State University

Sr. C. Blair Allen, AID/Washington, División de Desarrollo Rural para Latinoamérica.

Enero 28, 1980 : Reunión en el Departamento Nacional de Planeación DNP, División de Cooperación Técnica.

Asistentes, además del Equipo Visitante mencionado anteriormente:

Dra. Nohora Bateman, Jefe, División de Cooperación Técnica, DNP

Dr. Gabriel Montes, Jefe, Unidad de Estudios Agrarios, DNP

Dr. Santiago Tobón, Director del PAN

Dr. Darío Fajardo, Jefe de Proyectos Pilotos, PAN

Dr. Henry Arboleda, Jefe Encargado, División de Corporaciones, DNP

Dr. Sergio Ardila, Técnico División de Corporaciones, DNP

AID:

Dr. David H. Schaer, Jefe, División de Desarrollo Rural

Sr. Marvin Cernik, Jefe, División de Salud, Nutrición y Población

Sra. Beatriz de Rodríguez, Asesora, Programas de Entrenamiento

Lo siguiente fué discutido y acordado en principio:

1. <u>Mecanismo a seguir en la implementación de las actividades del Título XII en Colombia.</u>

   La Dra. Bateman indicó que existe un Convenio Bilateral vigente firmado en 1962 entre el gobierno de los Estados Unidos y el gobierno de Colombia. (Se anexan copias en español y en inglés). Por lo tanto el DNP considera que este Convenio básico podría servir de "Convenio Marco" bajo el cual se podrían ejecutar los sub-proyectos o convenios de actividades específicas del Título XII, que fueran a llevarse a cabo entre instituciones de Estados Unidos y las correspondientes instituciones colombianas.

   Tanto el DNP como la AID consideran que no habrá ningún problema para la implementación de las actividades del Título XII en Colombia, después que se haya terminado la Misión AID.

2. <u>El Equipo Visitante presentó los siguientes tres aspectos a la consideración del DNP</u> :

   a) Programas de Investigación (CRSPs : Collaborative Research Support Projects).

   Fueron planteados programas de investigación, especialmente aquellos de importancia para el desarrollo de Colombia, tales como: nutrición humana, salud animal, sorgo, fríjoles, pasto caupí, suelos tropicales, acuicultura y rumiantes mayores y menores. Se da por anticipado que instituciones colombianas tales como el ICA y el INDERENA buscarán activa participación en varios de estos programas.

b) Donaciones pára el fortalecimiento de las Universidades.

Existen 42 universidades Americanas participando en las actividades del Título XII, las cuales han recibido donaciones para reforzar sus capacidades de trabajo efectivo en países en desarrollo. Varias de estas universidades han manifestado su interés de trabajar en Colombia.

Se consolidarán los esfuerzos de las universidades y los intereses colombianos, en base a los programas desarrollados mediante dichas donaciones.

c) Asistencia Técnica (actividades generalmente llevadas a cabo bajo los programas bilaterales de la AID). En Colombia el Título XII podría servir como un canal de comunicación para desarrollar proyectos específicos que incluirían asistencia colaborativa. Por ejemplo, asesoría en estudios sobre subsistenc del campesino, sistemas de estadísticas/información para llevar a cabo inventarios/administración de programas de recursos naturales, bajo el PAN y las Corporaciones Regionales respectivamente.

El Equipo planteó la importancia de establecer un mecanismo para llevar a cabo aquellos programas que mantendrían las relaciones de colaboración entre las instituciones del Título XII y las instituciones colombianas de investigación, enseñanza y extensión.

Se enfatizó la importancia de establecer procedimientos de colaboración rápida con el gobierno de Colombia, puesto que la AID está en su fase de terminación.

El Equipo visitante enfatizó también la naturaleza de colaboración que tienen estas actividades y la necesidad de una ayuda financiera conjunta. Los detalles para la financiación de actividades específicas se determinarán cuando se lleven a cabo los proyectos.

Una norma general en el pasado ha sido que un mínimo del 25% del total del presupuesto viene del país cooperante. De acuerdo con lo mencionado en reunión anterior, los fondos de la AID provenientes de préstamos de doble paso podrían utilizarse como contribución de la contrapartida, si se llega a un acuerdo entre la AID/Colombia y el DNP.

La Dra. Bateman hizo énfasis en la importancia de los programas de entrenamiento, mencionando la dificultad en obtener financiación para estos programas.

El DNP manifestó que ellos actuarían como agencia coordinadora para las negociaciones, diseño y aprobación de los proyectos específicos que se adelanten en Colombia dentro de las actividades del Título XII. Las entidades ejecutoras de los proyectos serían autónomas tanto en llevar a cabo los contratos como en la ejecución y administración de los proyectos específicos, de acuerdo con sus necesidades prioritarias.

Se propuso también que los programas podrían ser implementados a través de las Universidades (Universidad de los Andes, Javeriana, Valle, etc), por medio de arreglos especiales con COLCIENCIAS o por arreglos similares. Este convenio podría ser especialmente útil en el caso de las actividades de interés del PAN, puesto que el PAN no es una institución ejecutora.

Durante esta reunión se sugirieron también varias prioridades para posible colaboración del Título XII:

a) Actualización de información estadística y procesamiento de datos necesarios para las decisiones de planeamiento.

b) Asistencia (asesoría) para el desarrollo de proyectos agro-industriales, de procesamiento de alimentos, etc.

c) Desarrollo de sistemas para control de las deficiencias nutricionales, a nivel de subsistencia de grupos de población rural.

El Equipo sugirió que podría ser de utilidad que los ejecutivos del DNP visitaran los Estados Unidos en una época apropiada y tuvieran oportunidad de conocer los ejecutivos del BIFAD y visitar los posibles colaboradores del Título XII.

David H Schaer
DAVID H. SCHAER
Jefe, División de
Desarrollo Rural
AID
2-6-80

Nohora Bateman
NOHORA BATEMAN
Jefe, División
Cooperación Técnica
DNP

M. Cernick 2/6/80
MARVIN CERNICK
Jefe, División
Salud, Nutrición y
Población, AID

JERRY B. MARTIN
AID Representative

COLOMBIA

Economic, Technical and Related Assistance

Agreement signed at Bogotá July 23, 1962;
Entered into force July 23, 1962.

GENERAL AGREEMENT FOR ECONOMIC, TECHNICAL AND RELATED ASSISTANCE

Between The

GOVERNMENT OF THE UNITED STATES OF AMERICA

And The

GOVERNMENT OF COLOMBIA

WHEREAS the Government of the United States of America and the Government of Colombia desire to join in an Alliance for Progress based upon self-help, mutual effort and common sacrifice, designed to help satisfy the wants of the people of Latin America for better homes, work, land, health and schools, and

WHEREAS the Act of Bogotá [1] recommended that there should be established an Inter-American program for social development directed to carrying out measures for improving rural living, land use, housing, community facilities, educational systems, training facilities, and public health, and for the mobilization of domestic resources, and

WHEREAS the Government of the United States of America and the Government of Colombia agree upon the need for specific plans of action designed to foster economic progress and improvements in the welfare and level of living of all peoples of Latin America, and

WHEREAS the Government of the United States of America intends to furnish such economic, technical and related assistance to the Latin American countries participating in the Alliance for Progress as may be requested by them and approved by the Government of the United States of America in the light of the resources available to it and of the programs and self-help measures provided for in the Act of Bogotá;

NOW, THEREFORE, the Government of the United States of America and the Government of Colombia hereby agree as follows:

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[1] *Department of State Bulletin*, Oct. 3, 1960, p. 537.

ARTICLE I. – To assist the Government of Colombia in its national development and in its efforts to achieve economic and social progress through effective use of its own resources and other measures of self-help, the Government of the United States of America will furnish such economic, technical and related assistance as may hereafter be requested by representatives of appropriate agencies of the Government of Colombia and approved by representatives of the agency or agencies designated by the Government of the United States of America to administer its responsibilities hereunder. Such assistance shall be made available in accordance with written arrangements agreed upon between the above-mentioned representatives.

ARTICLE II. – To foster its economic and social progress, the Government of Colombia will make the full contribution permitted by its resources and general economic condition to its development program and to programs and operations related thereto, including those conducted pursuant to this Agreement, and will give full information to the people of Colombia concerning programs and operations hereunder. The Government of Colombia will take appropriate steps to insure the effective use of assistance furnished pursuant to this Agreement and will afford every opportunity and facility to representatives of the Government of the United States of America to observe and review programs and operations conducted under this Agreement and will furnish whatever information they may need to determine the nature and scope of operations planned or carried out and to evaluate results.

ARTICLE III. – The Government of Colombia will receive a special mission and its personnel to discharge the responsabilities of the Government of the United States of America hereunder and will consider this special mission and its personnel as part of the diplomatic mission of the Government of the United States of America in Colombia for the purpose of receiving the privileges and immunities accorded to that mission and its personnel of comparable rank.

ARTICLE IV. – In order to assure the maximum benefits to the people of Colombia from the assistance to be furnished hereunder:

(a) Property or funds used [1] to be used in connection with this Agreement by the Government of the United States of America or any contractor financed by that Government shall be exempt from any taxes on ownership or use and any other taxes, investment or deposit requirements, and currency controls in Colombia, and the import, export, acquisition, use or disposition of any such property or funds in

[1] Should read "used or".

connection with this Agreement shall be exempt from any tariffs, customs duties, import or export restrictions, import and export taxes, taxes on purchase or disposition and any other taxes or similar charges in Colombia.

(b) All persons, except citizens or permanent residents of Colombia, who are present therein to perform work pursuant to this Agreement, shall be exempt from income and social security taxes levied under the laws of Colombia, and from taxes on the purchase, ownership, use or disposition of personal movable property (including automobiles) intended for their own use. Such persons and members of their families shall receive the same treatment with respect to the payment of customs and import and export duties on personal movable property (including automobiles) imported into Colombia for their own use, as is [1] accorded by the Government of Colombia to diplomatic personnel of the American Embassy in Colombia.

ARTICLE V. – Funds used for purpose of furnishing assistance hereunder shall be convertible into currency of Colombia at the rate providing the largest number of units of such currency per U.S. dollar which, at the time conversion is made, is not unlawful in Colombia.

ARTICLE VI. –

1. This Agreement shall enter into force on the date on which it is signed by the two Government and shall remain in force until 90 days after the date of the communication by which either Government gives written notification to the other of its intention to terminate it. In such event, the provision of this Agreement shall remain in full force and effect with respect to assistance furnish [2] pursuant to this Agreement before such termination.

2. All or any part of the program of assistance provided hereunder may, except as may otherwise be provided in arrangements agreed upon pursuant to Article I hereof, be terminated by either Government, provided there is 90-day advance notice given to the other Government in writing if that Government considers that because of

[1] Should read "as is".
[2] Should read "furnished".

changed conditions the continuation of such assistance is unnecessary or undesirable. The termination of such assistance under this provision may include the termination of deliveries of any commodities hereunder not yet delivered.

3. The furnishing of assistance under this Agreement shall be subject [1] the aplicable laws and regulations of the Government of the United States of America, and the receipt of such assistance by the Government of Colombia shall be subject to the applicable laws and regulations of the Government of Colombia.

4. The two Governments or their designated representatives shall, upon request of either of them consult regarding any matter on the application, operation or amendment of this Agreement.

5. Upon its entry into force, this Agreement will supersede the Agreement relating to general technical cooperation effected by an exchange of notes signed at Bogotá March 6, and 9, 1951, [2] as extended and amended by the Agreement effected by an exchange of notes signed at Bogotá on December 20 and 27, 1951, [3] and the Agreement relating to economic assistance effected by an exchange of notes signed at Washington on March 30 and April 4, 1961. [4] Arrangements or agreements implementing the above mentioned Agreement, as amended and extended, and concluded prior to the entry into force of this Agreement shall, from such date of entry into force, be subject to this Agreement.

Done in Bogotá, Colombia on July 23, 1962, in quadruplicate, two in the English language and two in the Spanish language, all being authentic.

For the Government of the United States of America	For the Government of Colombia
FULTON FREEMAN	JOSÉ JOAQUÍN CAICEDO CASTILLA
Fulton Freeman *Ambassador of the United States of America*	Jose Joaquin Caicedo Castilla. *Minister of Foreign Affairs*
[SEAL]	[SEAL]

[1] Should read "subject to".
[2] TIAS 2231; 2 UST 799.
[3] TIAS 2628; 3 UST (pt. 4) 4700.
[4] TIAS 4712; 12 UST 282.