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AN INTEGRATED CROP PROTECTION PROGRAM FOR PERU

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RECOMMENDATIONS

The writing team, having reviewed Peru's crop protection problems, its current resources to reduce those problems, and its institutional structures through which those problems must be addressed, and having examined the research, extension, and educational capacities of the country that focus on crop protection, believes that the time is right for Peru to mount a major, nationally coordinated effort in crop protection.

Current Status Of Integrated Crop Protection In Peru

The integrated crop protection (ICP) personnel that once exemplified the cutting edge of ICP in Peru have long since been dissipated and are now demoralized. The institutional resources and commitment in extension and research have been all but dismantled and discouraged. Only the educational institutions are intact and are committed to ICP.

Bank Loans For Crop Production In Peru

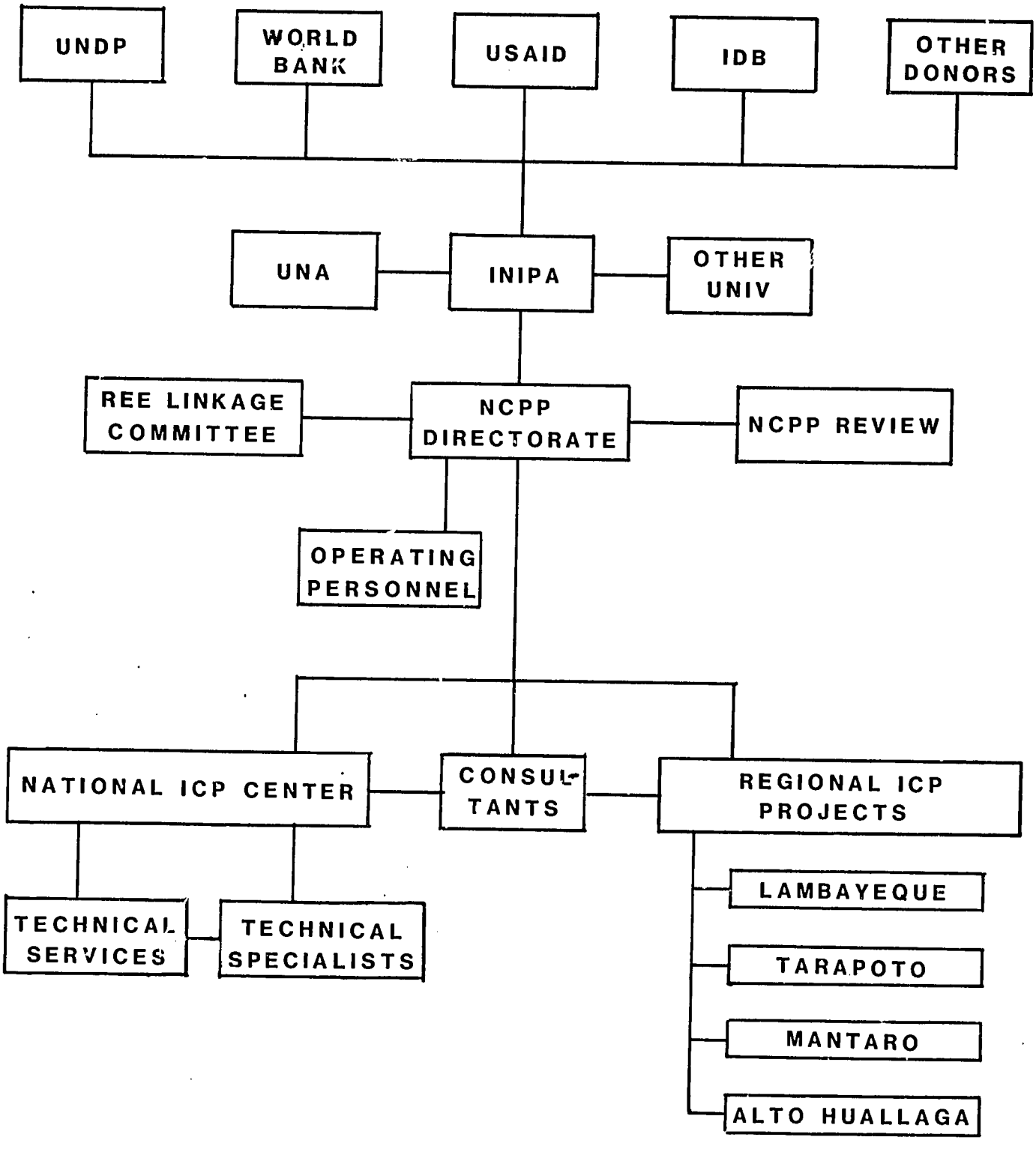
The recently negotiated loans and grants to the Government of Peru (GOP), mainly from the World Bank, the Inter-American Dvelopment Bank, and the United States Agency for International Development (USAID), have provided in excess of $100 million to upgrade agricultural production. A reasonable portion of these monies is meant to be used to reconstruct Peru's ICP component. Such a component must be solidly linked to the overall effort in crop production research, extension, and education (REE).

INIPA And UNA Work Together

This proposed ICP component, if it is to be successful, must result in the consolidation of existing dissipated talent. It must also result in a rekindling of the spirit of ICP that was once so evident in Peru. Because the Universidad Nacional Agraria (UNA) represents the current strong hold of human talent in ICP and because the Instituto Nacional de Investigacion y Promoccion Agropecuaria (INIPA) of the GOP represents the legal entity responsible for national crop protection, we feel a first step towards the reconstruction of an exemplyary ICP component necessitates the intimate and prolonged cooperation of INIPA and UNA. Neither institution alone could reconstruct the component; a partnership and team effort are required.

National Crop Protection Program (NCPP) (see figure next page)

We believe that INIPA, because of its legal responsibilities, must be in charge of any long-range national effort in ICP. We further believe that the format chosen by INIPA for its national commodity programs (DPNs) is an acceptable template upon which to construct a National Crop Protection Program (NCPP). We caution that parts of the NCPP might best be subcontracted to UNA (e.g. centralized services mentioned below, protection consultants, student theses, and all training/retraining programs). We also caution that the


UNDP
WORLD BANK
USAID
IDB
OTHER DONORS
UNA
INIPA
OTHER UNIV
REE LINKAGE COMMITTEE
NCPP DIRECTORATE
NCPP REVIEW
OPERATING PERSONNEL
NATIONAL ICP CENTER
CONSUL-TANTS
REGIONAL ICP PROJECTS
TECHNICAL SERVICES
TECHNICAL SPECIALISTS
LAMBAYEQUE
TARAPOTO
MANTARO
ALTO HUALLAGA

success of such a component depends upon the monetary resources available to achieve the desired goal. Not only is adequate funding of the utmost importance, but expediency, timeliness, and lack of bureaucratic tie-up are also of the highest importance.

The NCPP Directorate

We recommend that the NCPP be established and a Director and Co-director (together forming the Directorate) be chosen. Dr. Fausto Cisneros of UNA is the obvious choice for one of the two positions. Dr. Cisneros has credentials of an extremely high international caliber. He could easily fill either position. Furthermore, he has a pre-eminent reputation nationally and would command the respect a member of the Directorate would need to achieve desired goals.

The National ICP Center

The talent base for ICP in Peru is minimal. Even if expatriate and dissipated Peruvian talent were incorporated into the NCPP, enough talent could not be gathered to fully staff all of the experiment stations with highly qualified experts. The strategy we recommend is to concentrate the scarce national ICP talent at La Molina (utilizing the partership concept between INIPA and UNA) and have this talent available to help solve crop protection and technology delivery problems on a national level. In other words, these experts would be on call to regional and local projects to help set up proper experiments to solve specific problems. We suggest that this portion of the NCPP be given a cohesive name such as the National Integrated Crop Protection Center. Attached to such a center should be the highly trained experts in various crop protection disciplines and, as well, service-oriented efforts such as pest identification, literature assemblage, statistical, word processing, and editing capabilities. Many of these service-oriented efforts, we feel, should be subcontracted to UNA.

Regional Integrated Crop Protection Projects

A NCPP cannot be initiated at full capacity at every experiment station in Peru. Moderately qualified talent and funds for this sort of all-out effort do not exist. Instead, we recommend that pilot ICP projects be initiated at sites where other DPNs are headquartered. The sites we feel should contain strong ICP projects are 1) The Lambayeque Valley, 2) Tarapoto, 3) The Mantaro Valley, and 4) The Alto Huallaga. The first three sites will deal mainly with ICP of annual food crops, the fourth with ICP of perennial crops. These pilot projects should cover the major crops of the region and the ICP talent at each should form cohesive units we are terming Regional ICP Teams (RT). These teams should have the basic responsibility of establishing integrated crop protection procedures for the crops of the area. They should work across crops on a regional basis. Their findings should form the technology base that should be transferred through the Training and Visitation (T & V) methods already a part of extension. Attached to and forming an integral part of each RT should be one or two crop protection extension specialists. They will form the bridge between the RT researchers and the

T & V extension specialists.

Training and Retraining

Perhaps the most urgent and important recommendation is for massive training in ICP. Without it, the program cannot endure over the long-term. With it, such a program could flourish. Intensive courses in ICP and pesticide safety have already left their collective mark on the ICP talent of Peru. Unfortunately, that is not enough. UNA must be given ample support to process many Ingenieros Agronomos in ICP over the next five to ten years. It must also process a number M.S. level scientists in the various ICP-related curricula it offers. Many of the most promising scientists must be sent abroad for training at the Ph.D. level, especially in the ICP disciplines not well represented in Peru today, e.g. vertebrate pest management specialists, weed scientists, nematologists, and technology transfer communications specialists. Many of these Ph.D. scientists when they return to Peru should be employed by UNA to strengthen UNA's capabilities to train Ing. Agr. and M.S. level scientists, mainly for INIPA.

Vertebrate Pest Management Situation

Because no one currently exists in Peru that can take charge of and develop the vertebrate pest management aspects of ICP, we have proposed a crash program in this area (see Annex F). It should not be divorced from the overall NCPP but it should form a high priority within the National ICP Center.

Centro de Introduccion y Cria de Insectos Utiles (CICIU)

CICIU is a valuable and unique unit within INIPA. One of the priority concerns is to infuse that institute with much needed operating funds and to draw it into the main decision-making operations of the National ICP Center. Its focus on biological control must be coordinated with the overall focus of the NCPP.

Regional ICP Projects and Budgetary Considerations

Actual RT projects have not been spelled out in this document. We feel that once the overall concept of the NCPP is accepted and its formation set in motion, the scope of research and extension of each RT, as well as actual team composition, can be delineated. Similarly, a budget has not been compiled for the program as a whole nor for various portions there of. The writing team does have preliminary, albeit sketchy, budgets and many ideas concerning RT scope for each region. We would be most willing to put our thoughts into a document if and when that amount of detail will serve the ends of establishing a comprehensive crop protection program for Peru.

GLOSSARY OF ACRONYMS

AID	Agency for International Development, USA
AID/PERU	United States Agency for International Development, Peru Mission
AID/WASHINGTON	United States Agency for International Development, Washington Office
BAP	Banco Agrario del Peru
BIFAD	Board for International Food and Agricultural Development
CATIE	Centro Agronomico Tropical de Investigacion y Ensenanza
CGIAR	Consultative Group on International Agricultural Research
CIAT	Centro Internacional de Agricultura Tropical
CICIU	Centro de Introduccion y Cria de Insectos Utiles, INIA, Peru
CICP	Consortium for International Crop Protection
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo
CIP	Centro Internacional de la Papa
CRSP	Collaborative Research Support Program
DPN	Director de Programa Nacional
DWRC	Denver Wildlife Research Center
ECASA	Empresa Comercializadora del Arroz S. A.
ENCI	Empresa Nacional de Comercializacion de Insumos
FAO	United Nations Food and Agriculture Organization
FOPEX	Fondo de Promocion de Exportaciones No Tradicionales
GOP	Government of Peru
IARCs	International Agricultural Research Centers
ICP	Integrated Crop Protection
IDB	Inter-American Development Bank
INIPA	Instituto Nacional de Investigacion y Promocion Agropecuaria

INTSOY	International Soybean Program
NCPP	National Crop Protection Project
REE	Research, Education and Extension Project
RT	Regional ICP Team
T & V	Training and Visitation Approach To Extension
UC/AID	University of California at Berkeley/AID Pest Management Project
UNA	Universidad Nacional Agraria, La Molina, Peru
USAID	United States Agency for International Development
USDA	United States Department of Agriculture

ACKNOWLEDGEMENTS

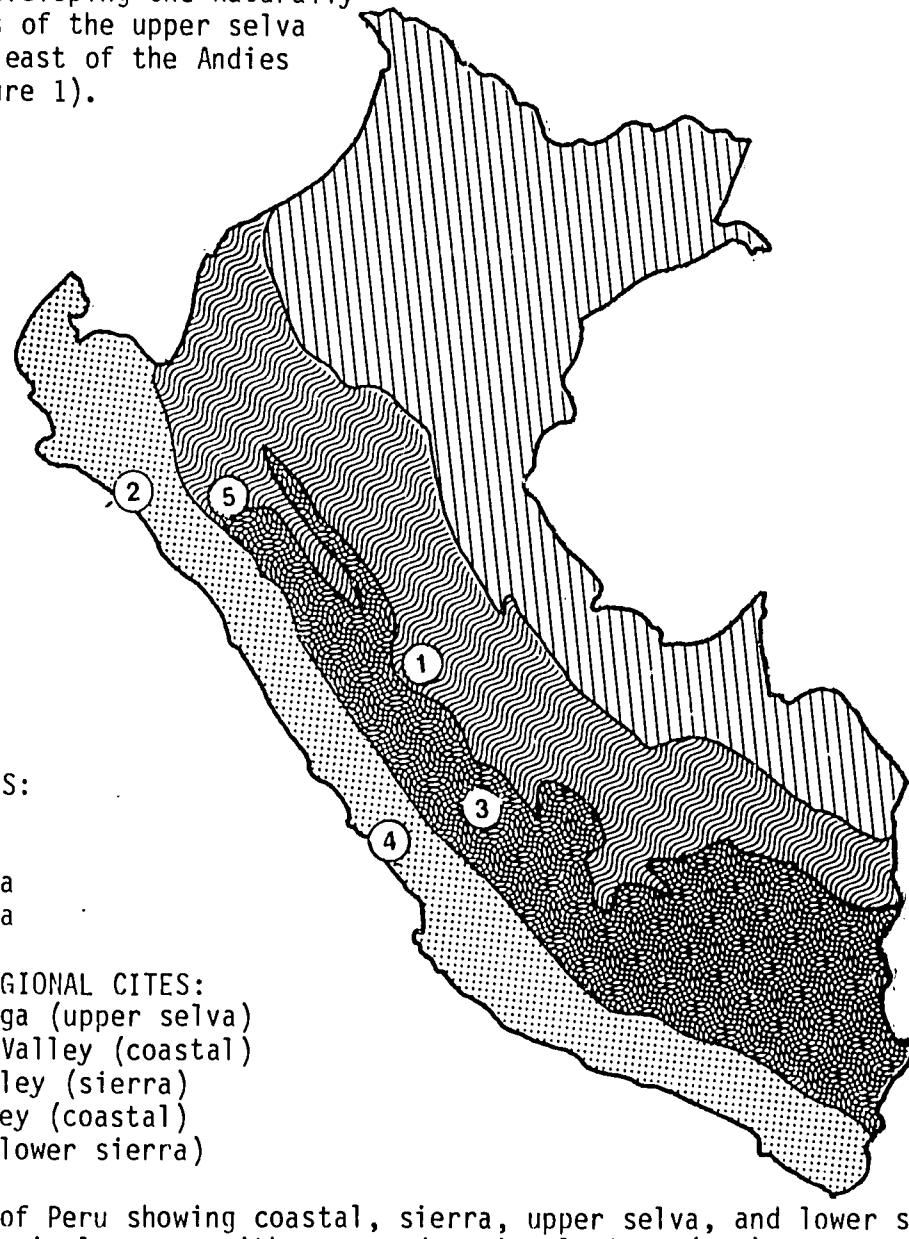
It is difficult to express the gratitude we feel for the many wonderful contacts we made during the study visit and during the writing of this report. We sincerely thank all of those we contacted for their time, effort and support during the course of this study. Many of the people are listed in Annex 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.

We especially wish to thank the members of AID/Peru for support during our stay in Lima. Jack Rosholt was very encouraging about integrating ICP into the Alto Huallaga Project, John O'Donnell and Loren Schulze took time during their last days before mission departure to help orient and encourage us. David Flood will play a vital role in the future of this potential project. We also extend sincere appreciation to those of INIPA and of the REE North Carolina State Program for frank and candid discussions concerning the integration of ICP into a national plan: Carlos Valverde, Raul Figuroa, Carlos Miranda, Julio Bonavides, Dale Bandy, Larry Apple, and Pedro Sanchez. To those at UNA we express special thanks for their support and guidance in many aspects of this report: Fausto Cisneros, Julio Echevarria, Saloman Helfgott, Jorge Sarmiento, Manuel Canto, Ricardo Mont, Jaime Castillo, and Enrique Fernandez.

Special thanks are extended to Brenda Peters for typing and to Bonnie Irwin for editing the report. To our wives we owe much for their patience and understanding.

INTRODUCTION

Peru's agricultural food production is severely limited by two underlying constraints: 1) limited farm production and 2) a recent past political climate that has crippled the agriculture sector. Less than 3% of Peru's land surface is under cultivation. This restricted agricultural land base, coupled with Peru's high rate of population increase, is pressuring the current Government of Peru (GOP) to improve agricultural productivity on existing lands through a combination of irrigation and reclamation schemes and research and extension efforts and through expanding its agricultural land base by clearing and developing the naturally vegetated lands of the upper selva (jungle) zones east of the Andies Mountains (Figure 1).



ECOLOGICAL ZONES:
= coastal
= sierra
= upper selva
= lower selva

PROPOSED ICP REGIONAL CITES:
1. Alto Huallaga (upper selva)
2. Lambayeque Valley (coastal)
3. Montero Valley (sierra)
4. Canete Valley (coastal)
5. Cajamarca (lower sierra)

Figure 1. Map of Peru showing coastal, sierra, upper selva, and lower selva ecological zones, with proposed regional sites (1-5).

Source: Parker *et al.* 1982.

During the military regime of the 1970s, performance in the agriculture sector declined dramatically as Peru underwent a major land reform. Agricultural research was paralyzed and technical assistance was virtually eliminated as extension personnel became heavily involved in the agrarian reform. The division of land, mostly on a collective basis among laborers with little or no knowledge of cooperative management, proved a failure for the most part. Price controls, imposed by the GOP as a means of subsidizing the consumer, provided little incentive to the grower and were a primary cause of a continuing massive rural to urban labor migration. Agricultural production declined during the 1970s and Peru's balance of payments position deteriorated as food imports increased by more than 20% (World Bank 1982).

The present regime has declared that marketing of agricultural products will be uncontrolled except when the Ministry of Agriculture imposes limitations for reasons of public health, plant and animal quarantine, soil conservation, rationing of water, or conservation of biota. Price controls are only possible by Supreme Decree, and if subsidies are imposed, they are not to be at the expense of the grower (USAID/Peru 1982). Improving agricultural production in Peru is the GOP's top priority (USAID/Peru 1982).

All food, forage, and fiber crops grown in Peru are attacked by a complex of pest species, including a wide variety of weeds, viruses, fungi, bacteria, nematodes, insects, and vertebrates. These exact a heavy toll on potential quality and quantity of agricultural products (Beingolea 1973). In a country like Peru, it is almost impossible to stabilize and increase yields without a viable crop protection component that encompasses research and extension acitvities. Indeed, crop protection is one of the fundamental cornerstones of crop production and must be built solidly into the framework and infrastructure of the agriculture sector.

Because crop protection is so vital to the success of any crop production improvement program, the GOP requested AID/Peru to assess the crop protection problems of the country and asked for recommendations of viable solutions to them on a national scale.

RECENT INTEGRATED CROP PROTECTION DEVELOPMENTS

A preliminary study of crop production problems in Latin America was conducted in 1972 (Apple and Smith 1972). That same year multidisciplinary teams reported on the integrated crop protection situation in Central America (Caltagerone *et al.* 1972) and in parts of South America (Echandi *et al.* 1972). These and related activities in ICP were supported by the United States Agency for International Development (AID) through a contract to the University of California at Berkeley under a program entitled the UC/AID Pest Management and Related Environmental Protection Project. This project eventually evolved into the current Consortium for International Crop Protection (CICP) with Professor R.F. Smith as its Executive Director. This project has concentrated heavily on Latin America, emphasizing intensive 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. Two intensive courses on integrated crop protection were held at the Centro Internacional de la Papa (CIP) at La Molina, one in 1978 and one in 1981. A seminar on pesticide safety was held in Lima in late 1982.

AID also supports a weed science technical assistance and research program headquartered at Oregon State University. The program, emphasizing small farm weed management projects in Central America, Colombia, Ecuador, Brazil, and the Philippines, has conducted numerous intensive weed science courses throughout Latin America and in the United States of America.

The Denver Wildlife Research Center (DWRC), a facility of the United States Fish and Wildlife Service, Department of the Interior, located in Denver, Colorado, emphasizes research on the reduction of damage caused by vertebrate pests to agriculture and other areas of human endeavor. AID has supported developmental DWRC research and fact finding missions since 1967, including trips to Peru in 1977 (Mitchell 1977) and 1978 (Mitchell and Elias 1978). AID and GOP personnel, along with DWRC experts, discussed and summarized vertebrate pest situations and control possibilities in various parts of Peru.

The international agricultural research centers in Latin America--Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Centro Internacional de Agricultura Tropical (CIAT), and Centro Internacional de la Papa (CIP)--have added greatly to national ICP potential through identification of germplasm with resistance or tolerance to various disease-causing pathogens, nematodes and, more recently, insect pests. These Centers maintain active breeding programs, many of which focus on incorporating resistant traits in agronomically desirable phenotypes. Small farm cropping systems activities have been initiated at several Centers and at the Centro Agronomico Tropical de Investigacion y Ensenanza (CATIE) in Costa Rica, and their current emphasis on research of the total system (CGIAR 1978) is consistant with the objectives of integrated crop protection as defined in this document.

Peru, a pioneer in the modern concepts of integrated crop protection (ICP), has a long and historic involvement through its cotton industry. Many of its senior protection scientists are keenly aware of these concepts and are eager for the opportunity to once again put them into practice.

Besides Peru's historic involvement in ICP and the intensive courses in ICP offered at CIP in La Molina, several recent activities in Peru have contributed to the ICP approach to pest control. The AID/Peru project on soy and corn production on small farms (USAID/Peru 1976), contracted to the Univerity of Illinois at Urbana-Champaign and its International Soybean Program (INTSOY), initiated an insect pest management program for soybeans grown in the upper selva of Peru. This project built upon the knowledge base gained by plant protection personnel during intensive ICP courses and succeeded in defining and implementing a pest management program at the researcher and grower levels (Annex G)(Irwin *et al.* 1981a).

In 1980, a Title XII planning team for ICP in Latin America visited Peru and three other countries and recommended Peru as the primary country site for a Title XII Collaborative Research Support Program (CRSP) in ICP (Irwin *et al.* 1980). AID/Peru decided to complement its comprehensive research, extension, and education project (AID/REE), contracted to North Carolina State University (USAID/Peru, 1980), with a crop protection component from the ICP CRSP. Unfortunately, the Title XII ICP CRSP was not funded by the Joint Research Committee of the Board for International Food and Agricultural Development (BIFAD). Thus the AID/REE project became vulnerable because it lacked a

specific and adequate plant protection component. In 1981, Drs. R.F. Smith and J.L. Apple visited Peru and drafted a document outlining the commodity priorities for an impending ICP program at a national level (Smith and Apple 1981). Later, the Instituto Nacional de Investigacion y Promoccion Agropecuaria (INIPA) of the Ministry of Agriculture, GOP, requested AID/Peru to assemble a study team to evaluate Peru's ICP potential and develop outlines for a comprehensive national ICP program. The study was postponed because one team member was in Peru on another assignment, and so he was asked by AID/Peru to develop an independant discussion piece on an ICP program for Peru (Irwin 1981). AID/Peru, acting through AID/Washington, then contracted CICP to bring in a four member team to develop an ICP proposal with focus on the food crops emphasized in the REE project, i.e. rice, potatoes, corn, grain legumes (primarily beans, soybean, peanut and cowpea) and small grains (primarily wheat and barley).

Recently, INIPA was awarded two large loans in the crop production area, one by the World Bank (World Bank 1982) and one by the Interamerican Development Bank (IDB 1980). Each contains a crop protection component, but neither is specific as to how the protection components will function within the overall strategy of INIPA's crop production strategy. Meanwhile, INIPA has used some of the World Bank loan to contract an Israeli group, TAHAL, to implement a comprehensive and intensive extension program built on the concepts of training and visitation (T&V)(Benor and Harrison 1977). Although it is not known if the T&V concept is sufficiently flexible to accomodate the transfer of ICP technology to growers, a system of extension now exists and is available to attempt the transfer of such technology.

TEAM MISSION

The AID/Peru ICP Planning Team was specifically instructed to:

a) Define the nature and magnitude of ICP problems of Peruvian food crops emphasized in the REE document;

b) Assess the human, facility, equipment, and supply resources needed to carry out a national ICP program; identify shortfalls in resources to fulfill ICP needs; and determine to what extent these shortfalls can be met by recent and impending contracts between the government of Peru (GOP) and various funding agencies (AID, Interamerican Development Bank (IDB), the Food and Agricultural Organization of the United Nations (FAO), and World Bank); and

c) develop a strategy for implementing and managing a comprehensive ICP program for Peru.

TEAM COMPOSITION

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CROP PROTECTION: RATIONALE, CONCEPT, APPROACH

RATIONALE

Crop protection is a necessary and integral part of crop production. A concerted effort in crop protection for the Peruvian farm sector is justified from several standpoints, some of which will be discussed below. Data addressing these issues are scarce and their accuracy somewhat questionable. They do, nonetheless, serve as approximations of imputs and losses and therefore serve to point out the toll pests exert on the wellbeing of the agriculture sector of Peru.

Crop Loss Assessment

A symposium sponsored by the Sociedad Entomologica del Peru in 1973, addressing crop losses due to pests in the agriculture sector of Peru, brought available crop loss data together for the first time. These data were gathered during the late 1960s prior to the initiation of the agrarian reform. Because crop protection practices deteriorated during the 1970s, we feel that relative crop loss estimates due to pests increased substantially during the 1970s and early 1980s.

Beingolea (1973) estimated a national loss of equivalent land area planted to crops in 1967 at about 9.1% due to insect pests. Sarmiento (1974), in a more detailed analysis of crop production in 1971, concluded that equivalent land area loss amounted to 14.4% for insect pests alone (Annex B, Table 21). In the 1971 estimates (Sarmiento 1974), insect pests were found to have reduced yield by 13.4% and pests accounted for a 16.4% reduction in cash income to farmers. These estimates are somewhat higher than those of Beingolea (1973).

Arevalo, D. (1973a) estimated national losses of equivalent land area planted to crops in 1967 at about 15.5% due to plant diseases (bacterial, fungal, and viral), and documented yield reductions at 17.5% with an 11.3% reduction in cash income to growers (Annex B, Table 22). Nematodes caused dramatic yield losses according to Arevalo (1973b). These amounted to about 26% of the equivalent land area under cultivation, 27% reduction in yields, and 18.7% loss in cash income (Annex B, Table 23). Sanchez, D. (1973) documented high weed-caused losses as well, reporting that weeds caused crop reductions in the range of 22.3% with a net loss in cash income of about 20.3% (Annex B, Table 24). Losses due to vertebrate pests exceeded US$4 million in 1976 (Annex B, Table 20) (Ministerio de Alimentacion, Subdireccion de Sanidad Vegetal). These amounted to over 1% net cash loss.

Available data confirming crop losses support the supposition of widespread and staggering losses (Table 1). If these losses are summed, cash losses to growers for all crops and for all pest classes approximated an overwhelming 67.7% or US$ 188.5 million in 1967. This figure is too high, for one cannot assume that total crop loss is the sum of losses from each and every pest species. Interactions, still poorly understood, make such interpretations erroneous and misleading. Yield losses and accompanying data, presented for each pest class and for many of the major commodities grown in Peru (Annex B, Tables 20-24), only indicate preharvest losses. Sarmiento

(1974) suggested an additional 10% reduction due to postharvest attack by insect pests alone.

Monetary losses are an obvious result of reduced yields; however, price discounts levied for poor product quality also result in monetary losses. Thus pests cause monetary losses because they reduce yields and because they lower product quality.

Vertebrate pests are among the factors contributing to a widespread and acute disparity between population and available food in many developing countries. Historically, vertebrates have not received the degree of attention given to other agricultural pests. Vertebrate damage in agriculture involves a variety of crops and animal species (primarily rodents and birds), and it has become increasingly evident that they play a major role in limiting production. Direct losses to vertebrates occur throughout crop development and under postharvest storage conditions. Losses may alter the food value, as when rats selectively remove the germ from stored corn, or may result from contamination of food with urine, feces, feathers, or hair. Indirect losses may result from animals burrowing into earthen dams and levees. Some rodent species may significantly reduce reforestation potential, disturb rangelands, or severely damage orchards. Birds, sometimes numbering in the millions, can decimate grainfields. Associated diseases, which are infectious to man or domestic animals, are also an important factor.

Contacts with agricultural personnel, reviews of available literature, and first hand observations indicate that vetebrate depredations of agricultural crops occur throughout Latin America and are, in some instances, a limiting factor in agricultural production. Except in a few isolated cases, little organized and reliable information is available on the species and crops involved, the degree of damage, and the resultant impact on the agricultural economy. Meager attempts have been made to define the problems, or evaluate the suitability of control agents or methodologies, primarily because few of the persons responsible for crop protection in Latin American countries have little training or experience in vertebrate pest control.

In the absence of other data, information on crop losses in other Latin American countries compiled by the Denver Wildlife Reserch Center (DWRC) are presented to illustrate the potential severity of vertebrate problems. Rodent damage to corn in one area of Honduras during 1976 was estimated at 24-28%; rodent damage to rice in Nicaragua was estimated at 26% in 1971; observations of dove damage to sorghum plantations in Uruguay ranged from 30% to 40% in 1977; reports from a program in Nicaragua indicated losses of 34% and 21% in corn and beans, respectively, on small farms in the Matiguas area. An FAO plant protection bulletin states, "Disastrous crop lossess are reported repeatedly from Northeast Brazil. Argentina's crops are subject to severe attack by rodents. Rangeland destruction by rodents is an important problem in Chile". An April 1977 report of the Agricultural Attache in Guatemala stated that a DIB loan for planting African oil palm in the Aguan Valley of Honduras was "only 16% utilized, partially as a result of a rodent infestation that destroyed almost 500 has. of new plantings within a 2-month period".

These data emphasize the enormous impact pests of all classes have on production potential in Peru. In fact, pest complexes are so important that they constitute limiting factors to crop production in several areas of Peru.

Without a viable crop protection component in the agriculture sector, the potential to increase and stabilize yields in a country like Peru is severely restricted.

Table 1. Percentage preharvest yield loss for selected crops by various classes of pests in Peru, 1967 data

Crop	Insects	Diseases	Nematodes	Weeds
Grain Legumes	20	10	15	6
Maize	20	3	-	6
Potato	20	25	20	5
Rice	1	5	-	10
Small Grains	0	20	-	10
Banana	30	25	10	1
Cacao	10	20	5	1
Citrus	11	25	5	2
Coffee	1	5	5	5

Sources: Beingolea 1973, Arevalo, D. 1973a, Arevalo, D. 1973b, Sanchez, D. 1973.

Pesticide Use Assessment

Pesticides are used more for commercial production than by small subsistance farmers. 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 and the practice stems from a solid knowledge base of integrated crop protection.

Most of the pesticides used in Peru are confined to the coastal irrigated valleys. Nearly 30% of the farm units on the coast use pesticides of some sort and each unit spends an average of US$127 per season. About 5% of the farm units in the sierra use pesticides, each expending an average of US$13 per season. Even fewer of the farm units in the upper selva use pesticides (3%), but each spends an average of US$29 per season on these products (Table 2) (Beingolea 1973).

Table 2. Pesticide use by agricultural farm units in Peru, 1964 data

Farm Unit Pesticide Use	Coast	Sierra	Selva	PERU
Farm units using pesticides (%)	23	5	3	7
Expenditure (US$) per farm unit for pesticides, including farms not using pesticides	36	1	1	3
Expenditure (US$) per farm unit for pesticides for only those farms using pesticides	127	13	29	49

Source: Beingolea 1973.

In 1980, a group of agricultural chemical company representatives estimated that the annual sales of all pesticides in Peru was between US$ 12-15 million, approximately 50% being insecticides, 30% herbicides, and 20% fungicides (Irwin *et al.* 1980). Many of these chemicals are costly, being imported into Peru as raw or finished products (Tables 3 and 4). Large-scale growers with cash crops can and do afford crop protection through pesticide applications; small-scale farms, conversely, cannot afford to buy pesticides and therefore use far less.

Table 3. Importation of pesticides in kilograms by class, Peru 1970-1977

	Technical for Formulation	Forumulated for Direct Sale
Insecticides	5,444,700	2,291,900
Fungicides	1,923,000	3,092,700
Herbicides	1,364,000	4,325,100

Source: Victor 1982.

Table 4. Importation of pesticide products in kilograms, Peru 1970-1977

	Technical for Formulation	Forumulated for Direct Sale
Phosphates	2,710,228	1,689,527
Chlorinated Hydrocarbons	1,574,913	223,464
Carbamates	1,203,228	698,761
Amides	108,306	411,657
Dithiocarbamates	95,260	2,411,593
Sulfanated	25,814	467,827
Thiocarbamates	6,864	39,348
Triazines	21,340	1,132,159
Inorganic Salts	25,000	131
Mercurial	668	396
Phenoxy	-	1,115,937

Source: Victor 1982.

Cost analyses of soybean production in the upper selva of Peru showed that as much as 31% of direct production costs were attributable to pest control, mainly through labor for weeding and for chemical insecticides and their application (Table 5) (Harms 1981).

Growers usually rely on salesmen for guidelines on the use of pesticides, especially in the sierra and upper selva zones. Partly because of misinformation, many growers use chemical pest control when there is no need. On the other hand, certain crops in given areas ought to be treated that are not. A plausible explanation is that small-scale farms have a very limited amount of cash, and credit is too expensive to justify the purchase the chemicals and application equipment. At this point in time it is difficult to estimate the total value of chemicals that should be used. Imports of pesticides (Tables 3 and 4) could actually increase in some areas, at least over the short term, as an ICP program is developed. However, an objective of ICP is to minimize their use.

Crop Protection Problems

Very little has actually been published on the pests of major food crops of Peru. Most of the information given in Annex C came from plant protection scientists at the Universidad Nacional Agrarea (UNA), La Molina. To illustrate how tentative our knowledge is about pests and pest problems in Peru, we cite a recent publication by Nault *et al.* (1979) resulting from a survey of viruses and mycoplasma-like organisms (MLOs) of maize in Peru. This publication indicted that five viruses and two MLOs were found. Of these, only two viruses had previously been recorded from Peru.

Table 5. Soybean Production Costs in US$ Per Hectare in the Upper Selva, Peru

	Case A			Case B		
DIRECT COSTS			506.88			285.58
Land preparation		212.53 (42%)			60.00 (21%)	
scattering and burning	9.44					
cleaning bunds and canals	16.80					
plowing with tractor	70.00					
plowing with oxen	11.33					
discing with tractor	50.00			60.00		
crossing with oxen	9.33					
harrowing with tractor	7.33					
repairing bundoxen	4.96					
furrowing with oxen	33.34					
Seeding		68.46 (14%)			59.10 (21%)	
seed	20.00			27.30		
inoculant	8.22					
labor	30.24			1.80		
seeding with machinery				30.00		
seeding with oxen	10.00					
Pest control		80.16 (16%)			87.80 (31%)	
herbicide				3.20		
weeding labor	34.08			59.40		
insecticide	35.52			16.20		
insecticide application	10.56			9.00		
Irrigation		15.04 (3%)			0.00 (0%)	
labor	15.04					
Fertilization		0.48 (0%)			0.00 (0%)	
fertilizer	0.16					
labor	0.32					
Harvesting		130.21 (26%)			78.68 (28%)	
labor	109.60			63.00		
threshing by machine	1.41			4.50		
transportation	19.20				11.18	
INDIRECT COSTS			94.62			53.31
Administrative (8% direct)		40.55			22.85	
Interest (32% direct, 4 mo.)		54.07			30.46	
PRODUCTION COSTS			601.50			339.09
Yield (kg/ha)	2400			2167		
Cost Per Kilogram	0.25			0.16		
ENCI Buying Price Per Kilogram	0.336			0.336		
CROP VALUE PER HECTARE			806.40			728.11
PROFIT PER HECTARE			204.91			389.24

Case A: Jaen area, second season 1978, partly mechanized (mean of 15 farms).
Case B: Alto Huallaga, second season 1979, partly mechanized (mean of 2 farms).
Source: Harms 1981

The crops and associated pest problems of Peru can be divided into four ecological zones: coastal, sierra, upper selva, and lower selva (Figure 1). For this report, only the crop protection problems in the first three zones will be considered. Major pest species are arranged by pest type under each important crop in each of the three considered zones and a relative impact index is presented for each pest in Annex C, Tables 25-30.

The upper selva, characterized by humid, hot conditions, contains a multitude of tropical trees of economic importance including, citrus, cacao, coffee, and banana. These have a number of serious pest species (Table 6). Among the annual food crops, rice, maize, and soybean are the most important, having a distinct list of serious pests (Table 7).

Table 6. Key pests of perennial crops in the Upper Selva at Alto Huallaga

	Citrus	Cacao	Coffee	Banana
Vertebrates				
Mimus longicaudatus	X			
Insects				
Monalonion dissimulatum		X		
Ceratitis capitata	X			
Anostrepha fraterculus	X			
Aphis citricola	X			
Toxoptera aurantii	X			
Phyllocoptruta oleivora	X			
Hypothenemus hampei			X	
Leucoptera coffella			X	
Cosmopolites sordidus				X
Nematodes				
Tylenchulus semipenetrans	X			
Meloidogyne exigua			X	
Meloidogyne incognita			X	
Pratylenchus coffeae			X	
Radopholus similis	X			X
Viruses and Diseases				
Tristeza virus	X			
Phytophthora parasitica	X			
Phytophthora palmivora		X		
Marasumius perniciosus		X		
Rosellinia bonodes		X		
Hemileia vastatrix			X	
Omphalia flavida			X	
Pellicularia koleroga			X	
Pseudomonas solanacearum				X
Mycosphaerella musicola				X

Table 7. Key pests of annual food crops in the Upper Selva at Alto Huallaga

	Rice	Maize	Soybean
Vertebrates			
Sporophila spp.	X		
Oryzomys spp.	X	X	
Insects			
Sogatodes orizicola	X		
Spodoptera frugiperda		X	
Piezodorus guildinii			X
Anticarsia gemmatalis			X
Cerotoma arcuata			X
Nematodes			
Meloidogyne graminicola	X		X
Hirschmanniella sp.	X		
Aphelenchoides besseyi	X		
Pratylenchus spp.		X	
Paratrichodorus spp.		X	
Viruses and Diseases			
Piricularia oryzae	X		
Helminthosporium oryzae	X		
Hoja blanca virus	X		
Corn stunt spiroplasma		X	
Maize mosaic virus			X
Cercospora kikuchii			X
Weeds			
Echinocloa crus-galli	X	X	
Echinocloa colonum	X		
Ischaenum rugosum			X

The coastal zone, characterized by dry, hot conditions with all crops under irrigation, has several important annual food crops including rice, hybrid maize, beans, and soybeans in the north (Lambayeque Valley) and hybrid maize, potatoes, beans, and soybeans in the south (Canete Valley). These have a number of important pest problems (Table 8).

The sierra zone, characterized by dry, cool conditions, has yet another set of annual crops, including open pollinated maize, potato, barley, and wheat. These crops also have serious pest problems (Table 9).

Economic Benefits of Control

Economic losses from crop pests in Peru are large. This fact alone does not necessarily mean that control would be profitable for the individual grower. The level of pesticide application cannot be increased indefinitely without reaching a point where the cost is greater than the value of the additional product. The cost of control must at the very least be offset by the value of increased production or by the increase in value due to improved quality. The economic threshold concept, as discussed below, is a measure of

Table 8. Key pests of annual food crops of the Coast in the Lambayeque Valley (rice, maize, beans, and soybeans) and in the Canete Valley (maize, potato, beans, and soybeans)

	Rice	Potato	Maize	Beans	Soybean
Vertebrates					
Oryzomys spp.	X		X	X	
Sporophila spp.	X				
Phyllotis sp.		X			
Insects					
Sogatodes oryzicola	X				
Spodoptera frugiperda			X		
Diatraea saccharalis			X		
Elasmopalpus lignosellus			X		
Empoasca kraemeri				X	
Pseudoplusia includens				X	X
Epinotia aporema				X	X
Liriomyza huidobrensis		X		X	
Ceratoma fascialis					X
Anticarsia gemmatalis					X
Piezodorus guildinii					X
Scrobipalpula absoluta		X			
Pthorimaea operculella		X			
Myzus persicae		X			
Nematodes					
Meloidogyne graminicola	X				
Meloidogyne spp.		X		X	X
Aphelenchoi besseyi	X				
Hirschmanniella spp.	X				
Pratylenchus spp.			X		
Pratylenchus brachyurus		X			
Paratrichodorus spp.		X	X		
Viruses and Diseases					
Piririularia oryzae	X				
Bipolaris oryzae	X				
Maize chlorotic mottle virus			X		
Maize mosaic virus			X		
Bean common mosaic virus				X	
Uromyces phaseoli				X	
Soybean mosaic virus					X
Phytophthora infestans		X			
Potato leafroll virus		X			
Potato virus Y		X			
Potato virus Y plus potato virus X		X			
Weeds					
Echinochloa crus-galli	X				
Echinocholoa colonum	X				
Eclipta alba				X	X

Table 9. Key pests of annual food crops in the Sierra at Cajamarca and in the Montero Valley

	Maize	Potato	Wheat	Barley
Vertebrates				
Oryzomys spp.	X	X		
Insects				
Heliothis zea	X			
Spodoptera frugiperda	X			
Rhopalosiphum padi			X	X
Rhopalosiphum maidis			X	X
Premnotrypes sulturicalus		X		
Nematodes				
Pratylenchus spp.	X	X		
Paratrichodorus spp.	X			
Globodera pallida		X		
Heterodera avenae			X	X
Viruses and Diseases				
Maize rayado fino virus	X			
Phytophthora infestans		X		
Pseudomonas solanacearum		X		
Barley yellow dwarf virus			X	X
Puccinia striiformis			X	X
Helminthosporium spp.				X
Phytophthora erythroseptira		X		
Potato virus Y				
Potato virus X				
Weeds				
Raphanus raphanistrum			X	X
Brassica sp.			X	X
Bromus sp.			X	X

profitability, and profitability is a function of the cost of control as well as the price received for the product. Little research has been conducted in Peru to develop response curves for different control measures, important to the establishment of optimum control levels. Initially, control recommendations should be based on available information including that from other countries with similar ecological conditions. It is expected that such recommendations will increase profits, at least in the short run, but optimum of control must await considerable research.

A cost/benefit analysis is inappropriate due to a lack of reliable data. However, there is concensus among Peruvian agriculturists that pest control in some crops and in some areas is profitable. For instance, trials conducted by the Centro Internacional de la Papa revealed a return of US$8 for every US$1 spent on control of the Andean tuber weevil.

If use of chemicals can be reduced through an integrated approach to pest

management (and ICP specialists feel this can be achieved), desirable economic and environmental benefits should result. Production costs may actually decrease, resulting in higher net incomes to growers. Whether this extra income is spent for consumptive items or to expand the grower's capital investment, the multiplier effect should help stimulate the economy.

CONCEPT OF INTEGRATED CROP PROTECTION

There are many ways in which a crop protection component can be conceived, including a strictly chemical pesticide approach, an eradication approach, and a pest management (i.e., an integrated crop protection) approach. If it is to function well, the adopted component must take into account the control of several kinds of pests in several different crops in any given locality.

The only system to embrace these diverse needs is Integrated Crop Protection. The major purpose of ICP is to develop strategies to protect crops from damage caused by several pest complexes. At the same time ICP should minimize the use of chemical pesticides, powerful weapons at the disposal of agriculturalists. This will reduce health hazards and environmental contamination, lower the risk of pests developing resistance to these chemicals, decrease the possibility of secondary pest outbreaks through pesticide-induced depletion of natural enemies, and minimize crop protection costs.

The nature and severity of crop protection problems varies from crop to crop, season to season, and region to region within Peru. For sound ecological and economic reasons, pesticide use on crops should be restricted to situations where treatment is absolutely necessary. The ICP concept insures timely applications of adequate but minimal pesticide dosages.

Integrated crop protection is the selection of practices that will assure favorable economic, environmental, and social consequences through the use of appropriate cultural, biological, and chemical control measures (Kogan and Kuhlman 1982).

Integrated 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 programs. These components include: 1) protection problem identification, 2) research directed toward solving the protection problem or problem complex, generating technology and, 3) a reliable and dynamic delivery system capable of mobilizing the technology and getting it to the farm systems. To carry out these components an adequate cadre of trained personnel is needed. These persons must have the necessary equipment, supplies, and backup to carry out these components. Inherent in the component system 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 integrated crop protection program, and

it is foolish to contemplate implementation of ICP 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 ICP programs.

Component 1: Protection Problem Identification

Problem identification 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, below).

With weeds, fungi, bacteria, and vertebrates, Irwin *et al.* (1980) found almost no problem in Peru regarding the gathering of the causitive agents or their subsequent identifications. Researchers, 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 though herbicide injury was virus-induced while many virus problems were diagnosed as nutritional deficiencies. Nematodes and the crop damage they caused were largely ignored, although there are two nematode diagnostic centers in Peru, one at INIPA La Molina and one at INIPA Vista Florida in the Lambayeque Valley.

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. 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.

As an example, CATIE scientists 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 resulting mis-identifications could lead to disasterous situations. Approximately 10% of the identifications are made by national staffs, usually university or 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 and given a name. The name, often the specimen too, is returned to the sender. This 5% adds up 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, Annex D). With the increasing load of identifications from the United States and decreasing resources to meet these needs, it is possible that the Systematic Entomology Laboratory will be forced 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 beneficial arthropods, a cut back, in the identification service would likely result in a worsening of the ICP situation throughout Latin America. Peru, under the REE program, has plans for 5 diagnostic centers, but these will not handle insect identifications (Irwin *et al.* 1980).

Component 2: Research Directed toward Solving Protection Problems

An integrated crop protection program has several phases of development (Irwin *et al.* 1981a, 1981b), the first of which is the *construction of a basic technology package* of best estimate practices for crop protection. This phase provides growers immediate access to technology that currently exists from research conducted in Peru and elsewhere. Thus this initial phase has the advantages of setting limits on pest population suppression at the outset and begins to acquaint growers and extension specialists with the concepts and practices of integrated crop protection through the implementation of supervised control procedures (i.e. scouting activities). Growers and extension personnel can quickly and simply be taught the necessary techniques to implement the program such as how to monitor pest incidence and abundance and how to treat pests when they surpass estimated economic thresholds.

By providing an interim control strategy for pests and diseases, albeit a largely chemically oriented strategy, valuable time is gained during which research efforts can focus on other phases of the program. The first phase identifies probable pest species, determines sampling procedures from literature and common knowledge, best estimate economic thresholds, and chemical control measures to take if and when pest populations exceed threshold limits.

Economic aspects of crop protection have received considerable attention in recent years. A concept that has become common in crop protection models is "economic threshold." Several definitions of the term have been offered, but the simplest and most meaningful for practical purposes is "the level of pest infestation at which it becomes economical to initiate treatment." While the economic threshold provides a good starting point for developing ICP strategies on small farm units, it serves only as an estimate because of the many factors that need to be included but are extremely difficult to quantify.

Incidence or numbers alone do not determine an economic threshold. It is dependent on: 1) economic factors, such as the cost of control (chemicals, labor, credit, and in cases where weeds are used for livestock and/or human consumption, the value of weed loss due to control), 2) pest-crop relationships such as percentage yield loss at various stages of crop and pest development, 3) dynamic factors, including pest growth rate, populations, stages of growth, and migration, 4) effect of destroying beneficial insects, plants, or animals, 5) the risk bearing attitude and ability of the grower, and 6) the relationships among different crops grown in proximity. The economic threshold is a function of all these interrelated factors and may vary at different points in time (McCarl 1981).

The second phase of the program concentrates on *determining the population dynamics of pest species* relative to crop phenologies. During this phase, research should be conducted to adjust economic thresholds, chemical pesticide recommendations, and sampling procedures. These research activities will determine actual pests in each crop, when they occur during the growing season which ones are they (i.e., which ones always surpass economic

thresholds), and more appropriate chemical control recommendations.

The third phase of the program is to *adjust the initial technology package* so that it more accurately reflects the pest situation and how to deal with it. Rather than a single phase in a long listing, this aspect must be thought of as recurring whenever new technology is developed.

The fourth phase of the program concentrates on *key pests and how to manage them with tactics other than chemical pesticides*. This means that each key pest of each crop of each region must be studied within the context of its environment.

The researcher should look for weak points in life cycles and for peculiarities in habitat requirements. Tactics, especially host plant resistance, biological control, and cultural control, should be explored. 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 augmented and passed on to extension personnel, people who deliver the technology to growers.

As these key pests are brought under control, to the point that they seldom surpass economic thresholds, fewer chemical pesticides should be applied. This assumes that the delivery end of the program is functioning properly and that these new technologies are continously being built into the existing technology package. Perhaps the most difficult part of this program is the transferof technology. It is discussed in detail under Component 3, below.

An agricultural economist can evaluate the different practices and interrelationships to determine the most profitable long-term control measures. This is no easy task because there are important exogenous variables that cannot be quantified. Initially, simple budgeting procedures will provide the basis for crop protection decision making. In fact, worksheets can be developed that extension personnel can use to help growers evaluate alternatives and make decisions. However, mathematical modelling may help ICP team members better address the interactive relationships. As the program evolves, more sophisticated models can be developed that will sharpen the focus of threshold limits and other important parameters.

Component 3: Delivery Systems for Transfer of ICP Techonology

The transfer of scientific agricultural technology from research scientists to growers, especially on small-scale farms, in Peru has been a major problem for a long time. The small-scale farmer does have "input" into his farming practices; however, it is usually not provided by national university, research, or extension scientists who are developing technology that could benefit this farmer. Some of the sources of information for the small-scale farmer are the following (Irwin *et al.* 1980):

Tradition and cultural background play a vital role in establishing the framework of operation for small-scale farmers. Their parents and grandparents taught them what they know about farming and to radically change their ways of doing things would create great inner conflict unless they are

convinced it is the right thing to do. Since, for the most part, their farming is at a susbsistence level and a crop loss means hardship for the family, the farmer is more likely to stay with that with what has been done in the past. Certainly many of the agricultural practices that the farmer learned from his ancestors are sound and effective. Others are less desirable; for example, in the highland areas of Peru farmers today favor a dark-fleshed traditional potato variety even though there are light-fleshed potato varieties that are comparable in taste, better for storage, more productive, and more resistant to many virus diseases.

Neighbors and other farmers are the source of input for small-scale farmers. This often involves peer pressure and can strengthen old tradi ions and cultural practices, making the acceptance of new agronomic technology more difficult. In some cases, however, peer pressure has been and can be directed toward implementation of new technology.

Agricultural chemical company representatives, are often able to have input into the farmers agronomic practices because their products can quickly and effectively bring insects, weeds, and diseases under control. Unfortunately, in many cases the farmer is unaware of the ramifications of excessive and improper pesticide use. There have been several serious examples of pesticide misuse (i.e., excessive levels of application and careless handling of the pesticide) resulting in hazards to the small-scale farmer, his crops, and his environment.

Extension and rural development specialists are a source of input for some small-scale farmers; however, the availability, acceptance and use of these organizations varies from area to area. In some areas extension specialists use bank loan clauses to pressure growers into adopting new technology, including the use of pesticides. Unfortunately, this system has in some cases become political and the small farmer can be hurt in the process.

The media of radio, television, newsletters, brochures, and a van equipped with audo-visual equipment have made information available to the small-scale farmer. As an example, extension specialists at INIPA in the Lambayeque Valley produce a column in the local paper each week dealing with a crop protection issue (Figure 2).

Demonstration plots, field days, producer or farmer meetings, individual farm visits and short courses run by university, research, or extension personnel have stimulated some growers to accept and adopt new technology. According to an extension worker in the highlands of Peru, one of the most effective means of encouraging growers is to have them come and talk together.

Cash crops such as coffee, cotton, rice, and sugar cane have associations that in Peru offer technical services to growers. The technician or representative of these associations, often a trained Ingeniero Agronomo, usually has significant input into the small-scale grower's practices for these crops. This practice has not been used for annual, local food crops, probably because strong organizations are currently limited to export and large-scale cash crops.

Figure 2. ICP Technology Transfer via Media Coverage. Lambayeque Valley'Perú.

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AGROPECUARIA

PLAGAS DEL ALGODONERO Y SU CONTROL

Controlar las plagas que atacan el cultivo del algodonero, constituyen diariamente motivo de preocupación por parte de todos los agricultores y entidades dedicadas a este cultivo, debido a que son ellas uno de los factores importantes que determinan el volumen de una cosecha y al mismo tiempo su calidad y costo de producción.

La Oficina Regional de Comunicación Técnica y Relaciones Públicas de la Región Agraria II—Chiclayo, con la colaboración del Ing. Alberto Pisfil Llontop, Entomólogo de la Sub Dirección de Agricultura y Ganadería, se ha preparado el presente artículo referido a una de las principales plagas que atacan al algodón y sus métodos de control, con la finalidad de incrementar el nivel de conocimiento de los algodoneros lambayecanos.

LA ARAÑITA ROJA DEL ALGODONERO

La arañita roja, es un arácnido muy pequeño, los adultos miden un promedio de medio milímetro de largo, siendo los machos algo más pequeño que las hembras; el color en los adultos varía, los machos van de amarillo pálido a verdoso y rojo carmín las hembras.

Las larvas tienen 6 patas; las ninfas y los adultos 8 patas. Los huevos son de forma esférica y de color blanquizco que los deposita en las hojas.

CICLO BIOLOGICO

El ciclo de vida ha sido determinado bajo condiciones controladas, en 24 días para los machos y 15 días para las hembras. En ambiente natural, esto puede variar de acuerdo a la temperatura, dándose el caso que en periodos calurosos con baja humedad se multiplican rápidamente, para luego declinar desapareciendo los estados inmaduros durante los periodos fríos.

En condiciones ordinarias una hembra deposita diariamente más o menos 6 huevos durante 8 ó 10 días, poniendo un total de 50 a 60 huevos.

DAÑOS QUE OCASIONA

Las arañitas rojas, pican las hojas y chupan la savia, de modo que estas toman una coloración amarillenta y luego rojiza en la cara superior las hojas se arrugan, se secan y luego se desprenden de las ramas.

La infestacion comienza por las hojas inferiores y progresan hacia las extremedidades superiores, hasta dejar en los casos mas graves, tallos desnudos quedando solamente 2 [illegible]

Por la pérdida de las hojas la planta queda muy perjudicada y no puede formar sus frutos en suficiente cantidad, originando lógicamente una disminución en la producción final.

HABITOS DE VIDA

Se encuentran en la cara inferior de las hojas formando grandes colonias que pueden extenderse a toda la superficie de la planta.

La arañita roja teje una densa tela de seda que le sirve de protección contra los enemigos naturales y medio ambiente.

El ataque se inicia desde muy temprano, incrementándose fuertemente hacia mediados de la floración, en razón que los ácaros adultos pueden desplazarse rápidamente a través de las hojas más no así en el suelo; los ataques iniciales se presentan casi siempre por focos, los que se van incrementando en tamaño al entrecruzarse el follaje de plantas vecinas.

DISPERSION

Puede desplazarse por el suelo para atacar otras plantas.

Por su reducido tamaño, pueden ser transportadas a mayores distancias por efecto del viento, generando focos de arañitas.

Asimismo, el hombre con sus implementos de labranza favorece su dispersión.

La arañita roja es altamente polífaga y es favorecida por ambientes secos y sombreados. La humedad elevada detiene severamente su desarrollo y limita su dispersión.

PLANTA HOSPEDERAS

La arañita roja se encuentra ampliamente distribuida en el Departamento de Lambayeque, atacando a casi 42 especies vegetales, tanto cultivadas como silvestres, destacándose entre ellas: Algodonero, frijoles, alfalfa, girasol, maracuya, camote, etc.

CONTROL CULTURAL

Es importante realizar las labores de Matada y Quema de los rastrajos inmediatamente despues de cosecha del algodonero.

De ser posible mantenga pulverizada la superficie del suelo, lo cual impedirá la migracion de las arañitas rojas.

Destruya las plantas hospederas, especialmente las malas hierbas, dentro y alrededor de los algodoneros.

Elimine y destruya por el fuego las primeras plantas infestadas.

Riegue cuando pueda, la humedad es perjudicial a su biología. Los campos con deficiencia de agua favorecen su rapida reproduccion y dispersion dentro del cultivo.

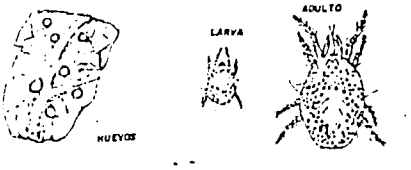
Cumpla con los periodos de siembra reglamentados.

No efectue rotaciones con cultivos susceptibles al ataque de arañita roja, tal es el caso de frijol, camote,

CONTROL QUIMICO

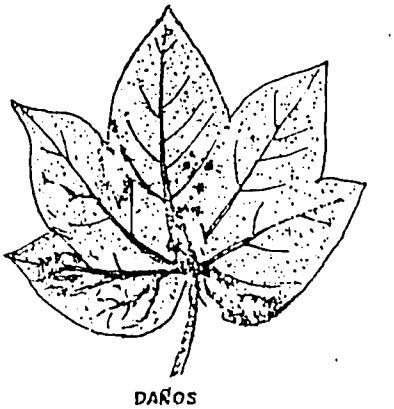
De persistir los focos de infestación por arañita roja, realice espolvoreos dirigidos a la cara inferior de las hojas, con azufre. Debiendo repetirse el tratamiento una semana después con el objeto de exterminar las arañitas roja, realice espolvoreos dirigidos a la cara inferior de las hojas, con azufre. Debiendo repetirse el tratamiento una semana después con el objeto de exterminar las arañitas que emergen de los huevos después de la primera aplicación.

Cuando se requiera la aplicación de otro tipo de acaricidas (productos químicos que matan ácaros) deberá consultarse a los especialistas del Servicio de Sanidad Vegetal de la Región Agraria II, FUNDEAL, Universidad Nacional Pedro Ruiz Gallo de Lambayeque o Centro de Investigación Agropecuaria del Norte.



CICLO EVOLUTIVO DE LA ARAÑITA ROJA

La arañita roja es de vida libre, ampliamente distribuido en el departamento de Lambayeque. Ataca especies vegetales cultivadas y silvestres. Se localizan en hojas, frutos y brotes, formando grandes colonias que pueden extenderse a toda la superficie de la planta si no se adopta adecuadas medidas fitosanitarias.



DAÑOS

La arañita roja al alimentarse del jugo celular destruye las membranas vegetales en el envés de las hojas. Grandes poblaciones de este ácaro determina la aparición de clorosis, las hojas atacadas son inicialmente "plateadas" para secarse y tomar un aspecto bronceado similar a las hojas secas. El ataque de arañita roja y su propagacion entorpece las funciones fotosintetica, causando serios daños a la planta atacada.

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

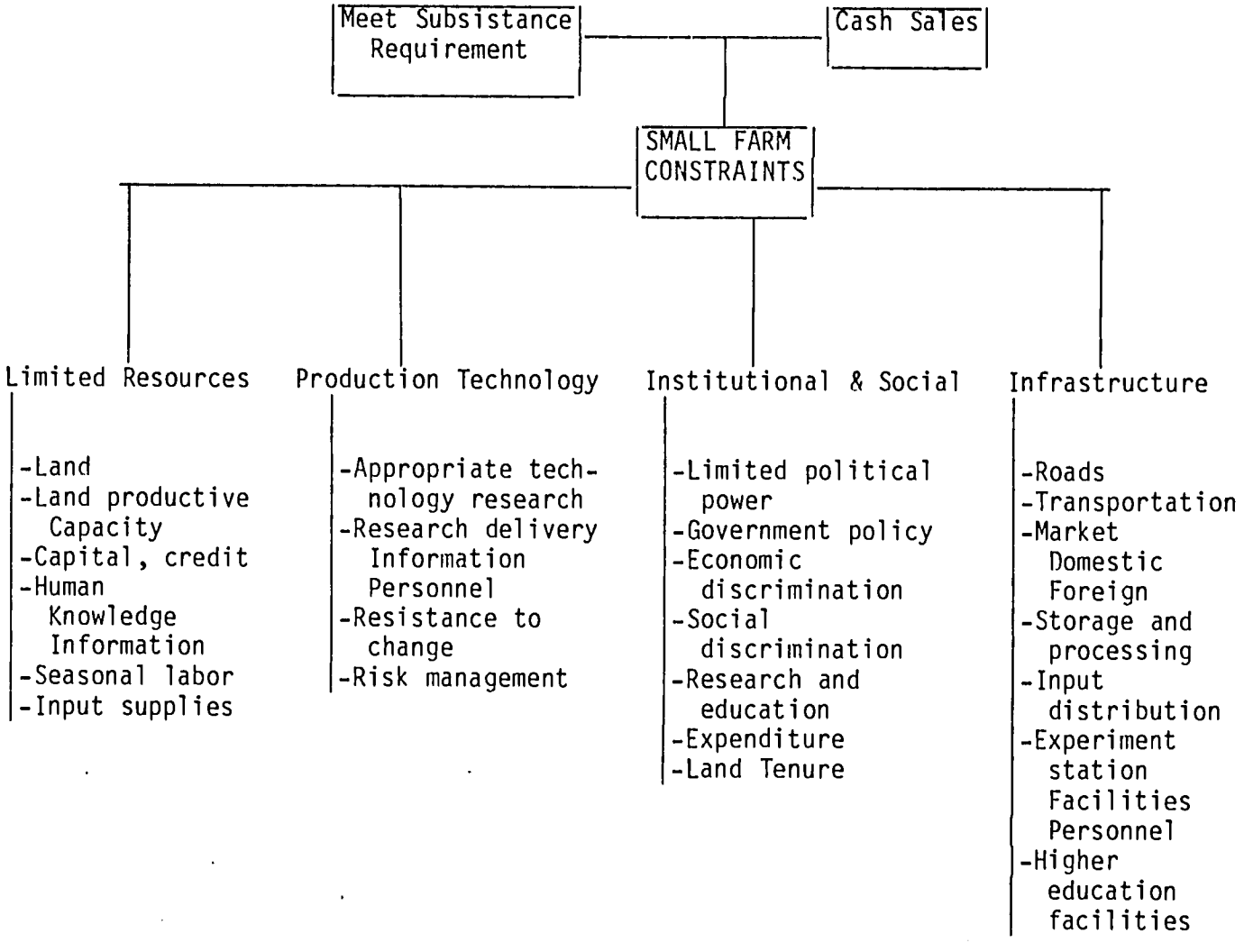
FARMING SYSTEMS, AN APPROACH TO INTEGRATED CROP PROTECTION

Integrated crop protection is a multidisciplinary approach to pest control. It involves managing all types of pests of a given crop throughout the growing season and during storage. Furthermore, intergrated crop protection cannot be restricted to a single crop in a cropping system in view of dynamic crop-crop, crop-pest and pest-pest interactions through space and time. Thus integrated crop protection fits more logically within the concept of farming systems (FS), and, within this, in cropping systems, than within the framework of crop commodities. For this reason, ICP must cut across commodity lines and should be developed around the concept of cropping patterns in given areas or regions. An ICP project for Peru must contain a component that addresses the major crops of selected regions.

Of the many factors that lead to the establishment of farming systems in Peru, 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. Because 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 farming systems can be composed.

The major categories of constraints faced by small-scale growers in meeting subsistence requirements and in generating cash income include: 1) limited resources, broadly including the productive capacity of the land itself, 2) production technology, 3) social and institutional limitations, and 4) infrastructure constraints (Table 10). Examples of issues that will need to be addressed include the interaction between livestock and cropping systems, seasonal labor requirements, and food preferences. Market constraints will continue to be serious problems demanding constant attention. Can the market absorb production increases through new technology at acceptable levels? What will be the effect on prices? Are storage facilities available so crops can be marketed in off-peak seasons? If additional land were brought into production at existing yield levels, prices would no doubt drop drastically for most crops (USAID/Peru 1980). It follows that yield increases resulting from improved crop protection practices could cause marketing problems because of oversupply. However, acceptance of ICP technology will likely occur rather slowly, allowing the market system time to adjust. Nevertheless, marketing is a problem definitely needing attention.

Table 10: Major constraints of small-scale growers in Peru.



Source: Irwin *et al.* 1980.

An analysis of these major constraints is beyond the scope of this proposal; it is important, however, to point out the need of addressing these issues as the project develops. Moreover, we do not propose that an analysis of institutional and infrastructural constraints be a part of the ICP program. These represent macrolevel problems that must be dealt with at the macrolevel, probably within the AID/REE program of INIPA. ICP technology, a microlevel technology, requires a farm management economist to evaluate the long-term economic strategy of crop protection practices within an appropriate resource and production framework.

Part of any farming systems approach is to first analyze existing information so that it can be used, among other purposes, to delineate agroclimatic 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. Agroclimatic zones are based on an environmental classification, and these

need to take into consideration an understanding of what aspects of the environment are critical to the adoption of technology and of the magnitude 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. In Peru, the principal annual crops grown in these zones are depicted in Table 11.

Table 11. Principal annual food crops in major ecological zones of Peru

	Coastal		Sierra	Upper Selva
Annual Crops	North	Central		
Maize	0	X	X	*
Grain Legumes	X	X	0	X
Potato	-	X	X	-
Small Grains	-	-	X	-
Rice	X	-	-	X

X = Very Important; * = Becoming Important; 0 = Moderately Important;

- = Not Important.

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 to describe various cropping systems (Table 12). 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 cropping (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 (Figure 3).

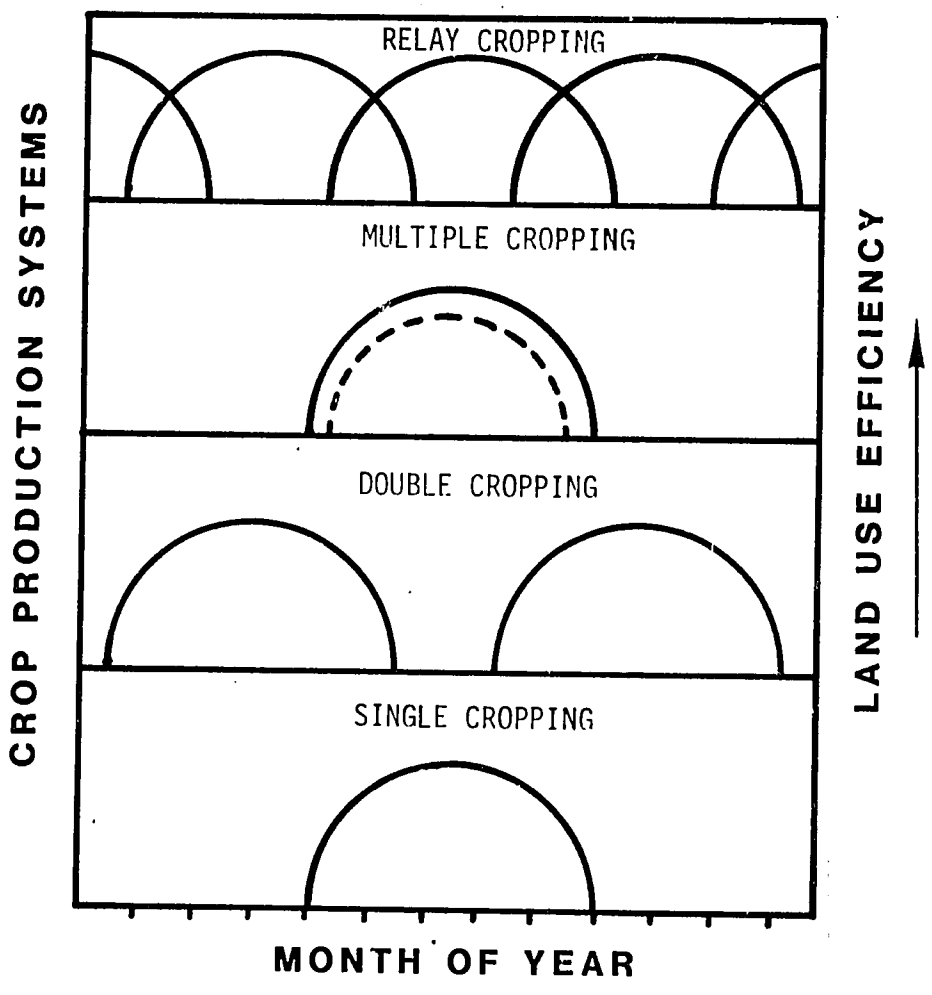


Figure 3. Principle crop production systems expressed as a function of time.

Table 12. Classification terms in farming systems research relating to crop production systems.

A CROP PRODUCTION SYSTEM comprises all components required for the production of a particular crop and the interrelationships between them and the environment. These components include all the necessary physical and biological factors, as well as technology, labor, 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 one year) this need not be so with multiple cropping.

The term CROPPING SYSTEM refers to the set of crop production 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.

Source: CGIAR 1978.

In Colombia, for example, the major crops of the three climatic zones have been categorized by how they are grown relative to one another within each zone by Alarcon *et al.* (1980) (Table 13). Some crops are grown in all zones and sometimes in several cropping patterns. For instance, maize is double cropped in the cool climate, but often intercropped or relay cropped in the moderate and warm climatic zones.

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. 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).

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, and beans. The extent to which these variable-purpose crops are grown depends upon access to a market and the infrastructure of the area.

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 crop protection constraints are discussed, for the severity and intensity of many of the pest problems of one crop are intrinsically woven with and drastically affected by other crops in the system and by various control practices employed.

Climatic and soil conditions strongly influence the choice of crops and cropping systems in the various regions of Peru. They also dictate weed complexes and severities. In turn, weed factors significantly influence cultural practices for given crops. Land preparation is an important factor that greatly influences the pest, especially weed, situation. All crops are completely dependent on irrigation in coastal Peru. 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, is generally treated with herbicides. Weeds are not serious constraints in the coast. For example, timely irrigation of beans reduced weed invasion by as much as 20% (Carrion 1975).

Low fertilization levels complemented by effective weed control resulted in greater yields and correspondingly higher net incomes, compared to high fertilization levels with ineffective weed control, in both maize (Takahashi 1974) and tomatoes (Casas Diaz 1979). One properly timed manual weeding equaled 1.5 kg/ha of atrazine in maize (Takahashi 1974). Chemical weed control in maize, however, has been shown to provide economic returns (Rivera 1982). Similar results were obtained in soybeans where fertilizer and weed management interactions were studied (Bullon 1982).

Small-scale family farms with limited capital and technical resources producing rather low yields typify agricultural production systems found on steep slopes of the sierra. Most land is worked by hand on the steep slopes

Table 13. Cropping systems of different climatic zones of Colombia.

COOL CLIMATIC ZONE

	Peas	Barley	Corn	Potato	Wheat	Garden Vegetables	Beans
Peas		Double crop	Double inter-cropping	Double inter-cropping	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

	Corn	Cassava	Vegetables	Coffee	Cacao	Plantain	Beans
Corn		Intercrop	Double crop Relay crop	----	--	Intercrop	Intercrop Relay crop
Cassava			Intercrop	Intercrop	Intercrop	Intercrop	Double inter-crop
Vegetables			Intercrop Relay crop	--	--	--	--
Coffee				--	--	Intercrop	--
Cacao					--	Intercrop	--
Plantain							--
Beans							--

WARM CLIMATIC ZONE

	Corn	Vegetables	Cassava	Rice	Sorghum	Soybean	Cacao	Sugar Cane	Tobacco
Corn		Intercrop	Double inter-crop	Double crop	Double crop	Double crop	Inter-crop	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		--	--	--	--	--	Inter-crop	Double crop	--
Cacao		--	--	--	--	--	--	--	--

Source: Alarcon *et al.* 1980.

while on the gentle slopes and flat land it is commonly worked by oxen and primitive plows. Tractors are rare in the sierra. According to growers, the soil needs tilling prior to planting.

Weeds are of minor importance in maize and potato production where cultural practices such as hilling are commonly used. Manual weeding is not commonly practiced in wheat, barley and oats, though weeds can cause serious losses in these crops. Certain weed species are consumed by humans and animals in some areas and this complicates weed control practices, especially where herbicides normally might be used. The availability of labor, small farm size, and lack of technical skills and capital all demand that weed management programs coincide with socio-economic constraints of the sierra. In some cases, small-scale farmers own knapsack sprayers for applying fungicides and insecticides in potatoes. These farmers could be taught how to apply herbicides correctly, but socio-economic aspects must be taken into consideration.

In view of the serious problems of soil erosion in the sierra, zero or minimum tillage practices, such as those developed by the OSU/AID/CATIE team in Costa Rica, should be studied. This practice greatly reduces soil erosion and has also reduced certain insect pests and increased fertilizer use efficiency (Shenk and Saunders 1981a, 1981b).

Weeds are a very serious problem in the upper selva, and much of the land is still farmed by the "slash and burn" system. Corn or rice is usually planted using a pointed stick during the first and second years. This is done under a no-tillage system. 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 some of it tilled by tractor. After 2-3 cycles of annual crops in newly cleared areas, grassy weeds tend to predominate and, if not properly managed, can decrease yields significantly. Establishment of perennial crops necessitates weed management, especially during the first two or three years. Soil conservation, cover crops, and reduced tillage systems should be an integral part of weed management in the tropics for sustained long term yields (Shenk *et al*. 1982).

Integrated crop protection is intrinsically linked with farming systems research. In fact, FS forms the parameters within which ICP must function. Without linking an ICP program to the broader FS concept, ICP can do little to improve the lot of the small-scale grower. ICP scientists must always keep in mind the larger picture while planning and executing ICP programs.

INTEGRATED CROP PROTECTION: RESOURCES AND CONSTRAINTS

When reviewing crop protection resources and constraints, the primary focus must be placed on institutions because, to a large degree, they set the quality and quantity of the other vital factors: personnel, facilities, supplies, and funding. There are two major institutions within Peru that have a strong emphasis in crop protection: INIPA and UNA. There are also several smaller national universities that play a substantial role in crop protection throughout the country.

It is important to view the institutions from a historical perspective to gain an appreciation of the political constraints they face.

Peru's research, education, and extension system is struggling desperately to recover from a sustained period of suppression and decline. Fifteen years ago Peru had one of the strongest such systems in Latin America. It is just beginning to recover from a period during which these services were deliberately dismantled, redirected, and neglected. The relevant institutions were severely handicapped in fulfilling their traditional roles and, as a result, most of their programs were weakened substantially or disappeared entirely. Thus a current assessment of those institutions must be made in the context of that recent history, still reflected in staffing patterns, quality and direction of programs, administrative philosophy and institutional performance (Yeutter *et al.* 1982).

To overcome the negative effects of the previous administration's excessive intervention in the agricultural sector, the GOP has chosen to pursue a policy in which private enterprise would be given more encouragement, GOP intervention in agricultural marketing processes, price controls, and consumer subsidies would be reduced, and a more balanced allocation of development resources throughout the country would be made. The GOP has also adopted a general policy to improve agricultural supporting services throughout the country to encourage agriculturalists to produce efficiently (World Bank 1982).

HISTORICAL PERSPECTIVE ON RESEARCH AND EXTENSION

Agricultural extension and research extend back more than 50 years in Peru. With AID assistance, the Interamerican Cooperative Service for Food Production, a semi-autonomous agency, was established in 1943 and provided 46 extension agencies throughout Peru. In 1952, AID also assisted the GOP in instituting the Cooperative Agricultural Research Program as a semi-autonomous agency that established experimental stations and undertook agricultural research to backstop extension work. In 1960, the two above agencies were combined in a new agency, the Agricultural Research and Extension Service (SIPA), so that GOP research and extension activities were in the same semi-autonomous institution. In 1964 SIPA and the National Office for Agricultural Reform were merged in a new semi-autonomous agency, the Institute for Agrarian Reform and Agricultural Extension (IRPA). The initial AID technical assistance program continued with the IRPA organization, and support

was also given to the Universidad Nacional Agraria (UNA). Cooperation existed between IRPA and UNA, and, through contractual arrangements, UNA staff members participated effectively in the national research program.

After the military Government assumed office in 1968, agrarian reform became the main policy priority in the agriculture sector, and in 1969 IRPA was integrated into the Ministry of Agriculture (MA). Extension staff were subsequently shifted to agrarian reform assignments, and budget constraints, coupled with the general neglect of extension and research, virtually destroyed these services that had been successfully developed during the previous 26 years. The de-emphasis on professional competence and activities, coupled with a decline in real terms salary scales in an inflationary environment, resulted in a large number of the most experienced and highly trained agricultural scientists taking up appointments in other countries. This serious "brain drain" hit very hard in the area of crop protection. This will require a major effort to redress.

The GOP made several institutional changes in the mid-70s to improve agricultural research and extension. However, severe budgetary constraints and the lack of qualified personnel counteracted the intent of these changes. The latest institutional change took place in 1981, when, under Legislative Decree No. 21 "Agricultural Sector Organization Law", the MA retained responsibility for policy planning and administrative, regulartory, and control functions in the agriculture sector. Direct responsibility for MA technical and support functions and activities was given to four semi-autonomous institutes and two public enterprises; of these, the National Institute for Agriculture Research and Extension (INIPA) was charged with responsibility for agricultural research, extension, farm mechanization, and rural marketing development.

Since INIPA's creation in January 1981, it has worked vigorously to organize itself for carrying out its research/extension responsibilities. Towards this end, INIPA has created and staffed 18 administrative districts for research and extension, called Agricultural and Livestock Investigation and Research Centers (CIPAs), each with its own Director who reports to the Head of INIPA (World Bank 1982).

TECHNOLOGY TRANSFER

University and national research and extension scientist have made considerable progress in developing new agricultural technology: however, only a small amount of this is being used by the small-scale farmer. Some of the constraints to the effective flow of this information follow (Irwin *et al.* 1980):

1. The researcher, who is academically trained, comes primarily from a family with financial means and from an urban environment. As a result he/she has difficulty relating to the small-scale grower's socio-economic situation.

2. Many researchers and those trained to communicate research information have had little experience on small-scale farms and therefore lack confidence and knowledge of farm activities. The small-sclae farmer senses this very quickly and has little or no confidence in the researcher.

3. Much of the research technology has not been tested in small farm situations under varying conditions. A number of technology failures at the farm level that may have worked well at the experiment station have left farmers sceptical of research "advances".

4. The pressure for new technology may not be felt by the small-scale farmer.

5. The small-scale farmer is often insensitive to the interests and activities of the researcher. A researcher with test plots on a small-scale 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 small-scale farmers.

6. The relationship between various scientific agricultural groups within Peru is often strained and sometimes competitive. Even having research and extension within a single institution has not completely eased the tensions. This environment makes a cooperative flow of information to the small-scale farmer limited and more difficult.

Considerable information is presently available for use in increasing yields and productivity. It is important to "package" that information into appropriate practices within the reach of all farmers. More importantly, farmers must have more than just information. They require technology appropriate to the farm system, timely *access to production inputs* (credit, Pesticies, scouting reports, etc.). The research and extension system gives high priority to the testing of existing knowledge at the producer level, and to strengthening information delivery systems (Yeutter *et al.* 1982)

INIPA is just beginning to mobilize its extension service. The main method of extension delivery will be the T & V system (Benor and Harrison 1977), in which the primary contact with the farmer is through sectoristas. These sectoristas have a predetermined number of visits to make every two weeks to a preselected group of farmers. In fact, the date and hour of every visit is set ahead of time so that the farmer will know when to expect the sectorista. Five farmers are visited each day. Every 15 days the sectoristas will receive group training at a central location, such as a research station.

An extension agent can supervise the work of several sectoristas. Field days and training workshops can be organized for growers. The sectorista will work with groups of growers rather than with individuals. Extension specialists will provide technical backup to extension agents and sectoristas. Such backstopping could be provided by crop production extension specialists.

The rigidity of the T & V system is a point of concern for ICP programs. There may be times when a sectorista needs to spend more time than alloted with a grower to accurately evaluate the seriousness of a pest problem. The sectorista may need to evaluate pest densities more frequently during rapid pest buildup than during other times. A rigid visitation schedule could act counter to the thrust of extension demands.

The delivery of appropriate technology to the producers is the bottom line of an ICP program. Extension specialists will have this responsibility. However, their responsibilities go far beyond the extension of technology. They represent the primary contact with the producer. It is they who ascertain the main production problems of the farmer and prioritize them so that the most pressing problems receive attention first. The extension agent must communicate these problems to the research component of the ICP team, otherwise the experiments that are conducted may have less relevance.

ORGANIZATIONAL STRUCTURE

INIPA is a decentralized public institution of the Agriculture Sector with the legal status of a publicly owned company. It will function for an unlimited time period with its legal residence in the country's capital.

The objective of INIPA is to contribute to an increase in the agricultural production and productivity with special emphasis on those products that are most important for food consumption in accordance with the policies of the Sector.

The functions of INIPA are: (a). Program, direct, manage, supervise, and evaluate the activities of agricultural farming research, use of water, and land use; (b). program, direct, supervise, and evaluate the operation of the agricultural extension offices of the Agriculture Sector; (c). program, direct, supervise, and manage the projects of the agricultural extension offices, considering the provision of support services to agricultural production; (d). provide farm machinery services to priority agricultural areas; (e.) promote, coordinate, and manage the operations aimed at increasing rural marketing, especially through marketing centers; and (f). other activities as provided by law (USAID/Peru 1982).

In general research and extension directives flow from the top downward in the two national and regional organograms (Figures 4 and 5). Funding also flows downward with very little getting to the researchers and extension scientists. Essentially, there is a siphoning off of funds at each level. On top of this organization chart is an overlay of national programs (DPN), each headed by a special director. Besides the vertical flow of responsibility and funding, a horizontal flow is injected. Several DPNs have been established, the one in the most advanced stage being the Potato DPN (Peru, Instituto Nacional de Investigacion y Promocion Agropecuaria. 1982). This appears to be a very appealing approach to cutting bureaucracy and funding delays. These DPNs attempt to gather available talent from INIPA and the national universities in a coordinated effort to solve commodity production problems. ~~An organogram of the structure of the National Potato Program is shown (Figure 6).~~ The one aspect of the DPNs that, in our opinion, appears to present serious problems is the lack of decision-making power in the hands of the DPN directorate. This is due to the fact that most of the funding for the DPNs is funnelled through the established, vertical system to the CIPA's and from

Figure 4. ORGANIZATIONAL STRUCTURE OF INIPA

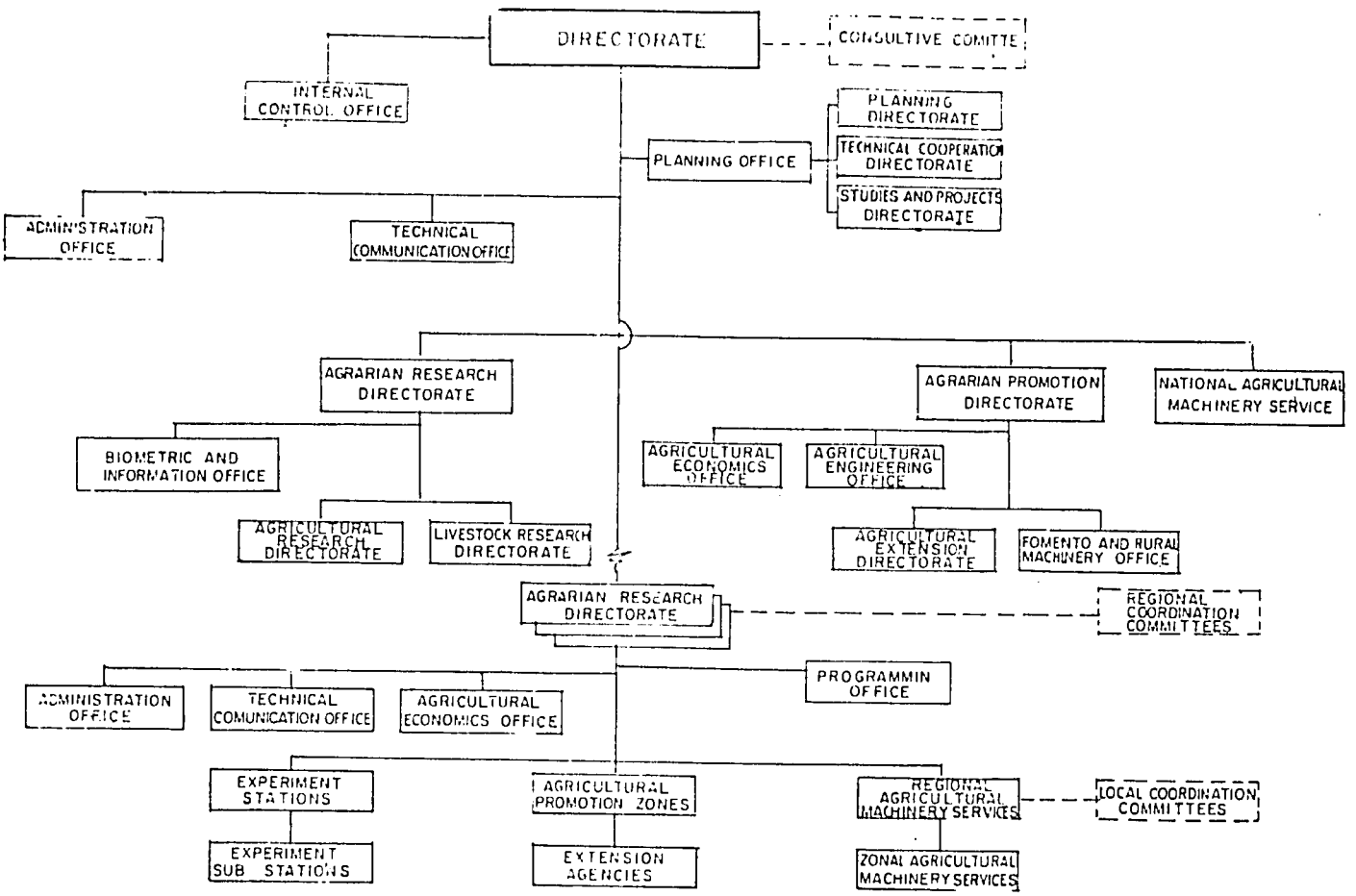
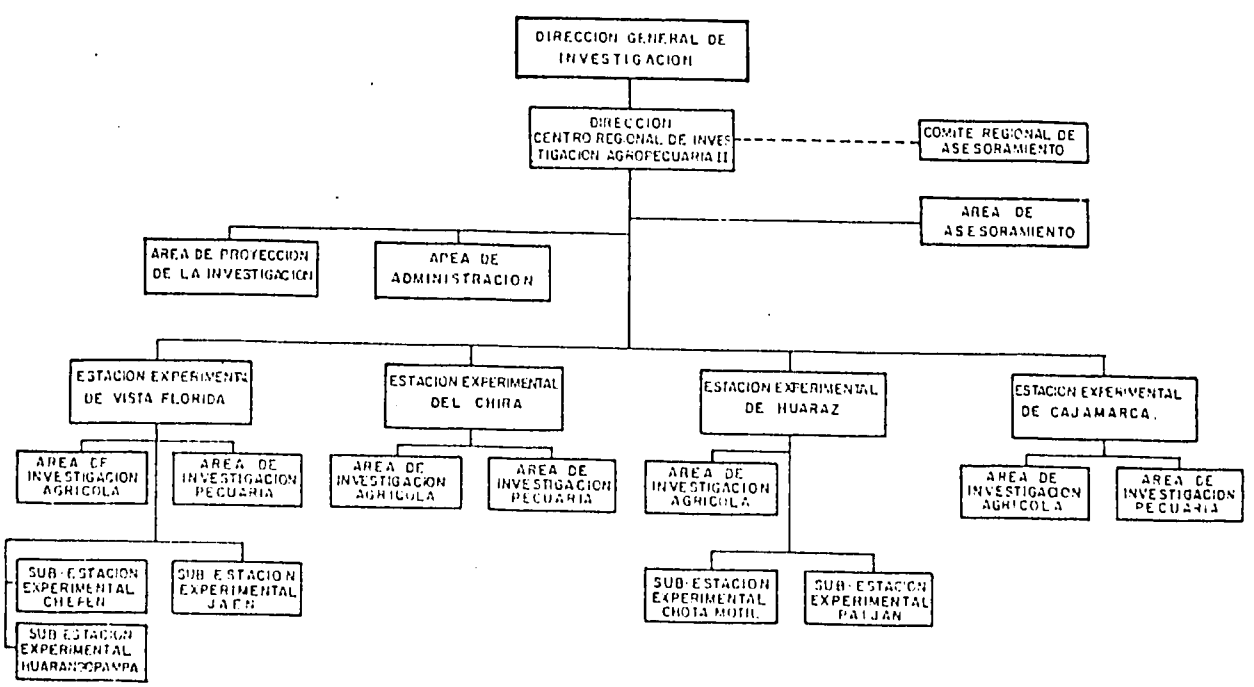


Figure 5. ORGANIZATIONAL STRUCTURE OF CIPA II



there to the Experiment Stations and then on to the Experiment Substations. That leaves the leverage with the CIPA and Experiment Station directorates, not with the DPN directorates.

UNA is a much broader based organization with a high degree of stability during the past two decades when what is now INIPA was undergoing violent changes. This stability factor may account for the fact that, in spite of a moderate rate of attrition due to resignation (Ardila and Penriro 1982), UNA continues to retain a large number of highly qualified and enthusiastic researchers/teachers. Compared with the situation at INIPA, moral at UNA is very high.

STAFFING

In research, all 17 stations and 27 sub-stations for crops and livestock located throughout the country were transferred from the National Agricultural and Livestock Research Institiute (INIA) to INIPA with their staffs. A total of 307 graduate staff, 304 technical staff, 242 clerical and administrative staff, and 125 other staff, including farm workers assigned to research, were involved in the move. On the extension side, a total of 885 personnel had been transferred from MA by June 30, 1981, consisting of 329 graduate, 197 technical, 351 administrative, and eight other staff (World Bank 1982).

The single most important common denominator affecting performance of the REE system, according to Yeutter *et al.* (1982), is the number and quality of professional staff. Throughout the entire system, a severe shortage of well-trained professionals exists. If these professionals were in place they would give leadership and dynamic direction to the various programs. The largest concentration of well-trained professionals is located at UNA, La Molina. It has a total of 40 Ph.D.'s (80% U. S. trained), 20 others with doctorates (not Ph.D.), and 106 with M.S. degrees (57.5% U.S. trained).

There have been a number of resignations even at this institution. Over 60% of the scientists that resigned from UNA took jobs with international organizations (Ardila and Pineiro 1982).

It is urgent for the short term that presently available talent from among the various institutions be mobilized into a cooperative effort to focus on critical priority areas, not only within agricultural production in the large sense but crop protection too. For the mid and longer term, a systematic and intensive program must be instituted to train scientists to fill key positions in the REE system. Although additional staff are needed at virtually all the experimental stations, the lack of trained personnel is the major staffing constraint. This deficiency can be overcome by a major program in staff training at the M.Sc. and Ph.D. levels supplemented with short courses in specific subjects, overseas visits to appropriate institutions, and the employment of high-caliber research scientists on a contractual basis for crop protection disciplines. Although Ph.D. level training must be undertaken externally, most M.Sc. training could be provided in Peru, particularly at the UNA at La Molina that has curricula especially strong in crop protection disciplines (Table 14; Annex E). A major technical and methodological training program is also required for the extension staff. A curriculum for this was recently assembled by UNA (Table 15). Contrary to the situation in

Table 14. 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 *
	Insect Systematics I *
	Insect Systematics II *
	Insect Anatomy and Physiology *
	Medical and Veterinary Entomology *
	Pesticide Management and Toxicology *
	Insect Ecology *
	Integrated Pest Control *
Plant Pathology:	General Plant Pathology
	Agricultural Plant Pathology
	Diseases of Industrial and Food Crops
	Diseases of Horticultural Crops
	Forest Pathology
	Micology
	Control of Plant Diseases
	Phytopathological Techniques *
	Advanced Plant Pathology *
	Physiology of Parasitism *
	Plant Pathogenic Bacteria *
	Plant Pathogenic Virus *
	Plant Pathogenic Fungi *
Nematology:	General Nematology
	Plant Parasitic Nematodes
Weed Science:	Weed Control

*graduate level courses

Table 15. New M.S. curriculum being offered at UNA La Molina in response to the REE directive to upgrade INIPA's extension component.

A. Undergraduate Courses Required for Admission

FT-331	Agricultural Technology
BI-111	General Botany
MT-201	Calculus II
FT-371	Crop Ecology
BI-213	Plant Physiology
MA-312	Agricultural Engineering
EP-101	Principles of Economics I

B. Required Undergraduate-graduate Courses After Admission

ES-314	Statistical Methods in Social Sciences
FT-471	Ecological Physiology of Crop Production
CH-271	Principles and Methods in Rural Extension

C. Graduate Courses Required for the Major

FT-773	Crop Physiology
FT-774	Systems and Methods in Crop Production
FT-681	Crop Production Extension
FT-783	Communication Techniques and Transference of Agricultural Technology
FT-793	Seminar in Crop Extension I
FT-794	Seminar in Crop Extension II
FT-798	Crop Extension Research

D. Elective Graduate Courses in Complementary Fields

CH-	Agricultural Extension and Rural Development
FT-682	Planning and Evaluating Crop Production Extension
EP-716	Agricultural Programming and Administration
CH-	Adult Education
SF-751	Advanced Soil Fertility I
EP-651	Formulation and Evaluation of Projects
EP-732	Advanced Agricultural Engineering
FT-671	Advanced Crop Ecology
FT-772	Physiology of Herbicide Action
FT-732	Production and Management of Certified Seed

Source: Cisneros, 1982.

Table 16. Staff of the Universidad Nacional Agraria related to crop protection, research and education

Fausto H. Cisneros	---	Ph.D. Entomology
Klaus Raven	---	Ph.D. Entomology
William E. Dale	---	Ph.D. Entomology
Teresa Ames	---	Ph.D. Plant Pathology
Enrique Fernandez	---	Ph.D. Plant Pathology
Salomon Helfgott	---	Ph.D. Weed Science
Carlos Lopez	---	Ph.D. Ecology
Manuel Canto	---	Ph.D. Nematology
Cesar Fribourg	---	M.Sc. Plant Pathology
Ricardo Mont	---	M.Sc. Plant Pathology
Jaime Castillo	---	M.Sc. Plant Pathology
Mario Zapata	---	M.Sc. Entomology
Juan Herrera	---	M.Sc. Entomology
Jorge Sarmiento	---	M.Sc. Entomology
Vicente Razuri	---	M.Sc. Entomology
Ulises Garcia	---	M.Sc. Entomology
Leonor Mattos	---	M.Sc. Plant Pathology
Monica Lazaro	---	M.Sc. Nematology
Ines Redolfi	---	M.Sc. Entomology
Menandro Ortiz	---	Doctor in Biology
Pedro Aguilar	---	Doctor in Biology
Isaias Combe	---	Ing. Agronomo, Entomology

INIPA, UNA has significant staffing strengths in crop protection disciplines (Table 16).

INIPA should take full advantage of scientific and technical personnel located in various institutions who can contribute to overall goals of the research program.

FUNDING

Almost without exception, institutional leaders in the REE system point to limited budgetary resources as a major constraint to their effectiveness. Although one might take issue with the "poverty syndrome", typical of many institutions, several obvious deficiencies do appear throughout the system.

Budget implementation is a serious administrative constraint in INIPA. The current system appears to be unduly centralized, with complicated procedures for submission, approval, and payment of expenditure vouchers. There are 15 or more steps in the expenditure process at the level of INIPA administration and several more at the level of regional CIPA's. This

staggering process reduces worker productivity and raises administrative costs. According to the finds of The U.S. Presidential Task Force to Peru, the budget implementation process takes so long that programs are impossible to carry out (Yeutter *et al.* 1982).

Funds for vehicles, buildings, and maintenance of equipment have been meager, while complicated bureaucratic procedures have impeded the flow of funds and sometimes prevented complete usage of the limited funds available. A common feature of agricultural research stations is the inadequacy of support facilities and services. Library and scientific information services, including biometrics and computing, are grossly inadequate and below the standard essential to support a viable research effort (except at UNA).

As a minimum, the national budget must sustain core costs of staff and operations at a level to assure adequate performance of the system. Expansion of the system beyond that which can be sustained must be avoided. This can be done only by avoiding duplication of effort among government agencies, careful delineation of priorities, the employment of staff who are essential to the REE activity, and careful use of physical resources (machinery, apparatus, and supplies). Collaboration between INIPA and other public and private institutions must be expanded. There are innumerable crop problems that need attention but are beyond the present capabilities of INIPA. Crop protection is one such problem. (Yeutter *et al.* 1982).

INIPA has more than 50 contractual arrangements with international agencies. The lack of strong coordination among these by a designated authority has reduced their potential impact. INIPA must struggle with the many requirements of negotiations, management, execution, and reporting for each contract.

The GOP has major bilateral or multilateral contracts that involve a substancial ICP component with the World Bank (World Bank 1982), the Interamerican Development Bank (IDB) (IDB 1980), the United Nations Development Program (UNDP/PERU 1982), and several contracts with USAID including the REE contract (USAID/Peru 1980), and the upper selva development projects (USAID/Peru 1975, USAID/Peru 1981a, and USAID/PERU 1981b). In total, these international funds add up to well over US$100,000,000, of which a substantial portion should be used for crop protection.

International funding can be enormously helpful in achieving desirable levels of operations, as pointed out in the Presidential Task Force document, but these levels must be *sustainable* upon termination of external support (Yeutter *et al.* 1982).

THE VERTEBRATE PEST MANAGEMENT SITUATION

Contacts with agricultural personnel, reviews of available literature, and first hand observations indicate that vetebrate depredations of agricultural crops occur throughout Peru and are, in some instances, a limiting factor in agricultural production. Except in a few isolated cases, little organized and reliable information is available on the species and crops involved, the degree of damage, and the resultant impact on the agricultural economy. Meager attempts have been made to define the problems,

or evaluate the suitability of control agents or methodologies, primarily because few of the persons responsible for crop protection in Peru have little training or experience in vertebrate pest control.

Crop loss data from vertebrates emphasize the enormous impact pests of all classes have on production potential in Peru. In fact, pest complexes are so important that they constitute limiting factors to crop production in several areas of Peru. Without a viable crop protection component in the agriculture sector, the potential to increase and stabilize yields in a country like Peru is severely restricted.

We propose a program of applied research and development of appropriate technologies along with a training and extension program designed to enhance host government capabilities in the specialized field of vertebrate pest control research and management. A significant initial step toward this end was taken with the establishment of a Regional Vertebrate Pest Control Project for the Caribbean (Project Number 598-0584). The project proposed in Annex F is viewed a logical and desirable addition of this initial effort, designed to serve the needs of a second major geographical region of Latin America, specifically Peru.

THE ENTOMOLOGY SITUATION

Entomology is more advanced in Peru than any other crop protection discipline. There are many trained entomologists with a broad understanding of integrated crop protection. The better trained entomologists can be found in UNA and other universities; only a few exist in INIPA. Major resources exist for developing a comprehensive applied entomology program; indeed, scientists at UNA have several effective programs, most notable being the maize program (Figure 6) (Cerrate 1979). The entomologists at UNA need financing so that they can become even more effective. The morale of INIA entomologist is generally low, mainly because of overwhelming bureaucratic procedures. The reserchers must punch clocks when they arrive and depart; scientists cannot function properly in this climate.

Centro de Introduccion y Cria de Insectos Utiles (CICIU) has the potential to become the premier biological control institute of Latin America a very short time, if properly funded. Although it falls under the auspices of INIPA, it maintains some degree of autonomy. It is staffed with well-trained, dedicated entomologists. CICIU must form a part of the eventual national effort on ICP but it should maintain some degree of autonomy.

THE PLANT PATHOLOGY - NEMATOLOGY SITUATION

UNA has the only cadre of well-trained plant pathologists. There is a dire need to expand the scientist base in Peru in this discipline. Even so, there are many more plant pathologists than there are weed scientists. Plant pathology covers such a large, relatively unrelated group of pests (fungi, bacteria, viruses, mollecutes, nematodes) that specialization within the field is necessary. While that leads to better science and better problem solving, it also requires a greater amount of training. Plant pathologists need a considerable amount of sophisticated, expensive equipment. It is important to keep in mind that most plant pathology training should be towards generalists with only a few centralized specialists.

Weed control has been discontinued at the UNA La Molina Cereal Grains Research Program. Numerous people are involved in weed control research with large commercial sugar and rice operations (cooperatives and private).

UNA La Molina and the universities at Tingo Maria, Lambayeoue and San Marcos appear to be viable institutions for weed science, although they suffer from inadequate funds. INIPA has potential for becoming a viable research and extension institute for weed control with the large financial and technical inputs now being received.

Good field and laboratory facilities exist at UNA La Molina. Inadequate transportation and limited operating capital are probably the most serious problems. Additional equipment will be needed if weed science is to be strengthened at UNA La Molina including laboratories and research land. Facilities and equipment, including transportation are extremely limited at the other universities and in INIPA.

THE WEED SCIENCE SITUATION

Dr. Salomon Helfgott, UNA at La Molina, has directed research and teaching in the university for 8-10 years. He teaches a comprehensive graduate level course in Advanced Agronomy Production, taken by about 45 students. In July 1982, the first M.S. specific degree in weed science was granted. Previous students have not specialized in weed science because few jobs are available. Commercial firms, agricultural cooperatives, and the Ministry of Agriculture offer only general production agronomist positions.

Although employed by Ciba-Geigy in Herbicide development, Ing. Rodolfo Vidalon teaches an undergraduate course in weed control at UNA, La Molina. Ing. Oscar Bullon, INIPA La Molina, has tested the effectiveness of herbicides for registration by the Ministry of Agriculture for the past 8-10 years.

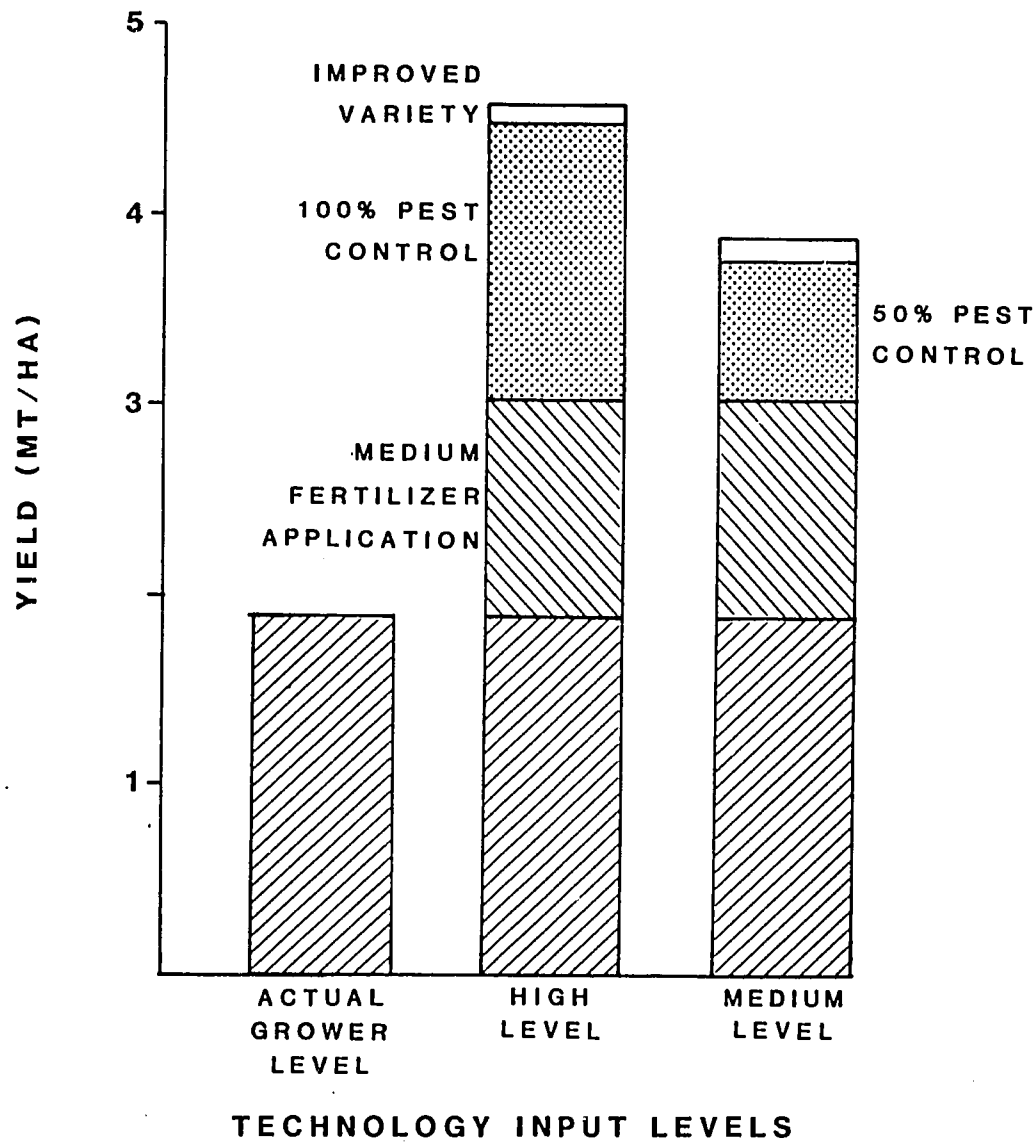


Figure 6. Increased yields due to better crop management of maize in Callejon de Huaylas, Peru. 1977-78. After Cerrate 1979.

Rudimentary weed control courses and very limited research are being conducted at UNAS, Tingo Maria, Universidad Nacional Pedro Ruiz Gallo, Lambaydque at San Marcos at Lima, and perhaps one or two other universities. At Tingo Maria, INIPA personnel are conducting limited weed control research as part of the INTSOY program.

For the well being of the agriculture sector, it is imperative that government authorities give recognition to the importance of scientific talent. Highly trained professionals are valuable national resources. They must be accorded adequate salaries and support resources if they are to be retained. Apart from higher financial rewards, there is a need to establish job satisfaction and a high moral within the structure. The alternative is a system whose staff is mediocre and unable to provide agriculture with needed leadership. The current salary and bureaucratic structures are such that the highly trained scientist is repelled and searches elsewhere for a job.

Special provisions need to be instituted to bring salary scales of professionals more in line with competitive salaries for similar competence. At the same time, full-time staff members should not be permitted to engage in activities that are in conflict with their official positions (Yeutter *et al.* 1982).

AN INTEGRATED CROP PROTECTION PROGRAM FOR PERU

The need for a national effort in integrated crop protection is self evident. Between the large toll pests exert on the potential yields of food crops, the numbers and diversity of major constraint pests, the unbalanced use of pesticides (many times pesticides are misused to the detriment of the environment and human safety), the lack of knowledge of how to manage many of the pest species on several crops in different agronomic zones, and the inability of extension to transfer the knowledge already accumulated to the grower, there is ample justification for a full-scale effort in crop protection. Trained personnel are at a premium and any serious consideration of a long-term solution to crop protection in Peru must include a vigorous training and retraining effort.

Because the GOP has placed highest priority on increased production and because several large loan contracts have been negotiated dealing with improved production, the climate is right for a concerted effort in ICP. Funds principally from the World Bank and USAID are being used by INIPA to initiate several national commodity programs (DPNs): rice, maize, potato, beans and other grain legumes, small grains, and pastures. While these programs are being superimposed upon the more formal structure of hierarchically arranged regional experiment stations and substations, the hope is that they will focus research attention on the major food crops of the country. Various regional experiment station networks, according to current INIPA dictates, are to be given sums of money that can only be used to enhance research efforts in these commodity programs. Each DPN is to have a Peruvian Director and an outside adviser who, together, ensure that the objectives and timetable of the national program are carried out.

There are many bureauratic problems that have to be worked out to insure that adequate funds for research in these areas are available when and where they are needed. Not only is there need for a strong monetary commitment, there is a dire need for expediency. A national program for integrated crop protection, if it were to follow the DPN template, would have a much more difficult mandate, primarily because it would have to function across commodity lines as well as across regional boundries. This would take commitment not only from the ICP Directorate, but from other DPN Directorates and higher administration within INIPA. It would also require a large cadre of well trained crop protection scientists in INIPA. That, unfortunately, does not exist at the present time. Most of the ICP talent currently exists within UNA, other universities, and the private sector. INIPA's ICP talent has been dissipated due to several factors. It is unrealistic to hope that INIPA could build up this talent bank in less than ten or fifteen years. A national ICP program, then, by necessity must involve UNA, other universities, and the private sector. These groups agree that a comprehensive strategy is needed to bring the dissipated ICP talent of the country to bear on the multi-faceted problems. The question is, how can this be accomplished?

While the potential organizational strategies for ICP in Peru may be infinite, three major modes seem possible: (1) wholley within INIPA and set up as a national program (DPN), (2) wholley within UNA that currently, because of its stability, relative lack of bureaucracy, and staffing superiority in ICP, could initiate a strong program, and (3) in a semi-autonomous

organization that could capture the strengths of both institutions and capitalize on the total resources of the country. There are arguments for and against each.

INIPA has the national responsibility in ICP and should have control of that segment of crop production. INIPA also has control over the REE program and a program in ICP not strongly linked with the resources of commodity programs will fail to focus on key constraints. UNA would definitely get an ICP program started in a dynamic manner, but, without the strong ties to INIPA, UNA would have a difficult problem in interfacing with the extension component, currently a part of INIPA. Also, to put the responsibility of national ICP in UNA's hands would counter the lawfull responsibilities of INIPA. A system that could combine the merits of both institutions and alleviate the problems of each might serve Peru best. Such a system would have to link firmly with the REE project and would have to depend on monies now in INIPA's possession. INIPA would have to contract a portion of its crop protection obligations to some semi-autonomous organization. This seems very doubtful considering the current political atmosphere.

The scenario most likely to succeed is the first, where INIPA is firmly in control of the program. But if the program is to have any chance of success, INIPA must tap the talent base residing in UNA, the other universities, and, to some extent, the private sector.

Several salient features must be incorporated into the national ICP program. First, the program must take full advantage of existing national expertise in ICP. Second, the program must have at its core a cadre of highly trained national scientists that can be called upon to help solve major protection problems throughout Peru. Third, the program must be intimately coordinated with the national commodity programs and must focus on the principal crops. Fourth, the program must begin with regional projects at the national commodity centers but develop crop protection strategies for all of the priority commodities of the region. Fifth, the program must have a substantial component in retraining of existing INIPA scientists as well as a long-term plan for training new scientists at several levels to staff the total program. Sixth, the program must have a dedicated, respected, and responsible director who can function at all levels with authority to implement decisions with adequate funding at hand. Seventh, the program must have cohesion such that all ICP specialists feel as though they are vital parts of an indispensable and well-functioning team. Eighth, functioning members of the program must be given a salary commensurate with their skills, and advances in rank and scale should be tied to the merit system. Nineth, the program must be monitored by an independent group of ICP specialists of international reputation. Tenth, the Consortium for International Crop Protection should play an advisory role in the development of the program, in contracting outside specialists, and in the everyday running of the program through a co-director.

Program Management

We propose that INIPA institute a National Crop Protection Program (NCPP) for Peru. It should be headed by a national director and an outside specialist who should assume the role of co-director. Together, this

Directorate should have the authority to formulate program policy and to develop national directives for crop protection.

The NCPP Directorate should be charged with the following major responsibilities:

1. Develop program activities

2. Distribute program responsibilities

3. Coordinate program activities

4. Insure proper linkages with other projects

5. Insure proper evaluation and redirection of program in light of program goals and evaluation recommendations.

A mechanism must be established whereby the directors of national commodity programs can communicate the protection needs of their commodities to the NCPP Directorate. There must be a mechanism by which research priorities among commodities and among protection disciplines can be established. These mechanisms will help focus the NCPP Directorate on the national protection issues needing urgent attention. It is here suggested that a committee composed of the national commodity Directorates be established and headed by the NCPP Director. Its function would be to set protection priorities on a national basis. It is further suggested that such a committee include or be closely advised by knowledgeable scientists at UNA. The committee should meet and set priorities not more than twice nor less than once each year.

Operating funds for the NCPP should be under the control of the NCPP Directorate. These funds should cover operating costs of administration, national crop protection scientists, national crop protection services, and regional crop protection projects.

The NCPP Directorate shall appoint an independent committee composed mainly of persons representing linkage organizations to award competitive grants for proposals dealing with appropriate science for solving crop protection problems in Peru. While adaptive, the science should be somewhat basic and innovative. These grants should be awarded mainly to scientists outside of the NCPP program.

An outside comprehensive review of the project should occur every second year. Evaluations and reviews should be organized by the Directorate to include no fewer than five (5) nor more than ten (10) external reviewers. External reviewers shall be selected by representatives of donor and linkage organizations from short lists supplied by the NCPP Directorate after consultation with representatives of donor organizations, internationally acclaimed experts in various ICP disciplines, and important commodity research and extension areas. Reviewer recommendations shall be implemented by the Directorate in accordance with available funding.

The National ICP Center

A cadre of ICP specialists from INIPA, La Molina and UNA will form the nucleus of the NCPP. This nucleus must contain the scare national ICP expertise who will serve the function of resource personnel to help solve the multitude of protection problems at all of the regional ICP sites. This cadre of specialists must consist of a minimum of one from each of the following disciplines: weed science, nematology, plant virology, plant bacteriology, fungal pathology, vertebrate pest control, and entomology to cover the major tactics (breeding for resistance, biological control specialist, cultural control specialist, and a toxicologist). The cadre must have a technology transfer or communication specialist and an ICP-oriented economist. It should be led by a broad-based integrated pest management specialist.

The National ICP specialists should be attached to INIPA, La Molina or to UNA and the leadership position should be selected with sensitivity to maximize the cooperation and team spirit within the group. One of the functions of the NCPP Directorate should be to insure a cooperative and collaborative spirit among the National ICP specialists.

Attached to this national cadre of ICP specialists must be an ICP service-oriented center. This must, at a minimum, include identification services for insects, nematodes, and plant viruses, literature specialists, and statisticians. It is evident to us that this service-oriented center should be attached to UNA, for all aspects are present in that institution and only lack funding to become productive and capable of servicing ICP needs on a national scale.

The National ICP specialists and the ICP service oriented center together forming the National ICP Center, shall be on call to help solve a multitude of problems including protection problem identification, research toward solving the protection problem or problem complex, and developing dynamic and reliable delivery systems. This center shall form a foundation that in the long-term can be expanded to serve the Peruvian Agriculture Sector on a broad and continuing basis. Such a center must also serve to strengthen the bonds between INIPA, La Molina and UNA (Figure 7).

CICIU should form a fundamental unit of the National ICP center. Basic funding for CICIU should be turned over to the NCPP and the CICIU director should become an advisor to the NCPP Directorate.

The NCPP Directorate shall call upon CICP for short-term specialist consultants when necessary to help solve problems beyond the immediate capability of the National ICP center.

Attached to the center should be a long-term consultant who would organize the vertebrate pest control program for the country. To date, Peru has no identifiable vertebrate pest control specialists and efforts to begin developing expertise and programs in this area are urgently needed (see Annex F).

The National ICP Center should also have word processing capabilities and adequate funding for publishing important articles. Research articles should be published through existing journals and these journals should be given

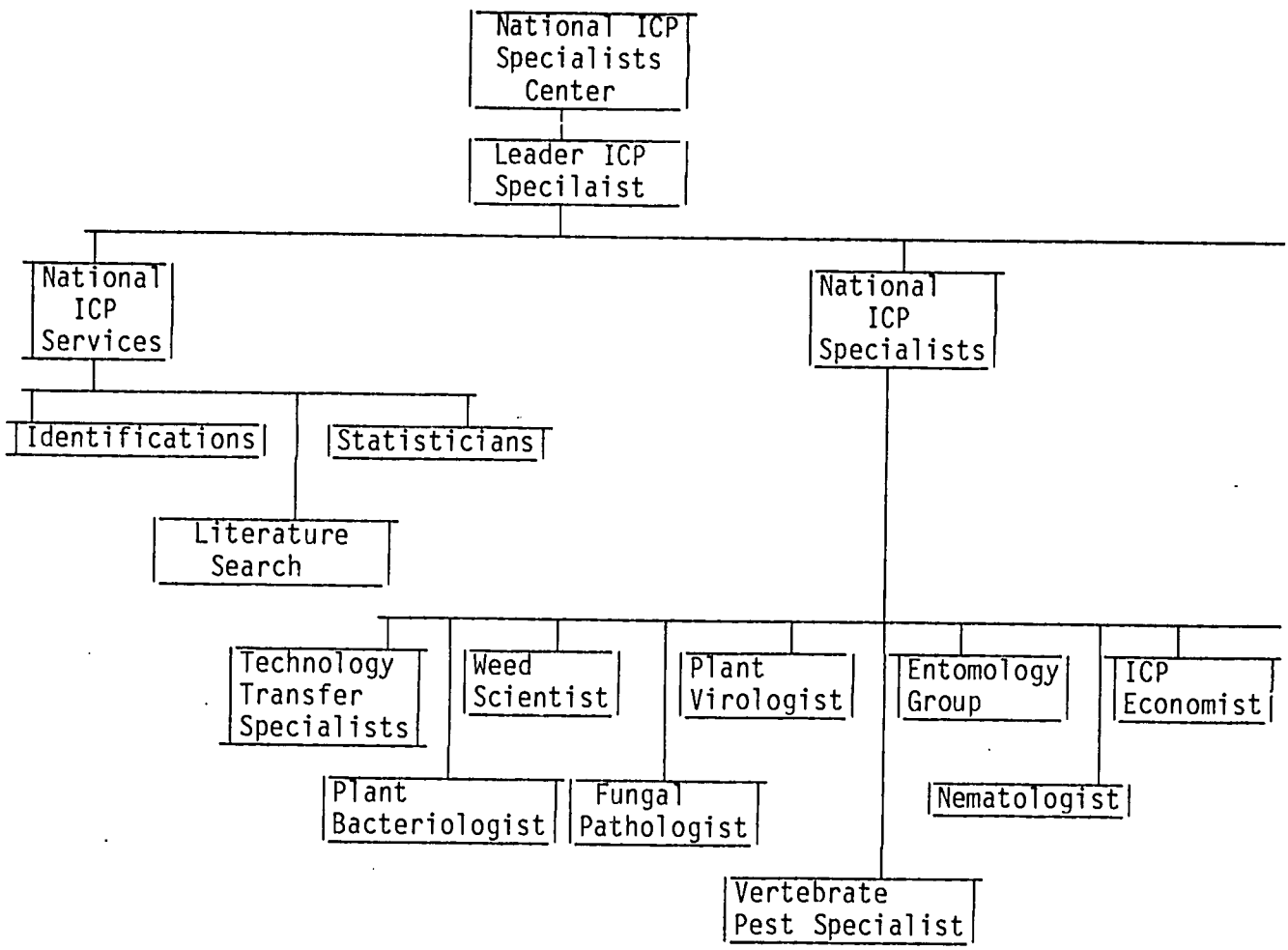


Figure 7. The National ICP Center

reasonable support.

The NCPP has a unique opportunity to develop as an insect identification center within the National ICP Services Center. This would increase the accuracy of pest determinations at regional sites. This in turn will open the literature to determine various control measures. This would also reduce the number of identifications currently going to the Systematic Entomology Laboratory (SEL) of the USDA, Beltsville, MD. For these fewer identifications, SEL suggested a yearly contract fee of $15,000 from USDA/Peru to make sure the service was continued during these times of severe cutbacks in program and personnel.

An insect identification center already exists at UNA. The NCPP program should provide one full-time curator/identifier on hard money, plus a rotating post doctoral/visiting scientist position in insect systematics, and a full-time curatorial assistant to handle the pinning, packaging, and technical aspects of the collection. There is also a need to gather relevant systematic literature for Peruvian insects. Thought must be given to diagnostic centers of the type discussed above, for proper problem identification is fundamental to pest problem resolutions.

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.

Regional ICP Teams

The NCPP Directorate shall be charged through the contract with establishing a minimum of three (3) and a maximum of six (6) Regional ICP Teams (RT) (Figure 8). Priority regions and subregions are listed in Table 17. RT leaders, one from each team, shall be appointed by the NCPP Directorate.

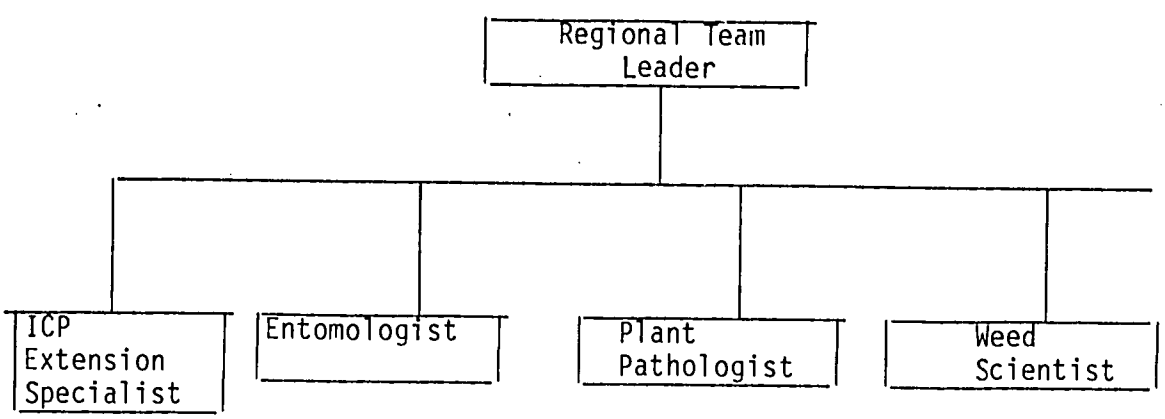


Figure 8. The regional teams and their make up composition.

Table 17. Priority listing of regional ICP projects in the NCCP program.

Priority	Region	Subregion	Locality	Institutes
1	Selva Alta	Central	Tarapoto	INIPA
2	Coastal	Northern	Lambayeque Valley	UNPRG INIPA
3	Sierra	Central	Mantaro Valley	UNCP INIPA UNA
4	Selva Alta	Southern	Tingo Maria	INIPA UNAS
5	Coastal	Central	Canete Valley	Est. Exp. (Private) INIPA UNA
6	Sierra	Northern	Cajamarca	INIPA UNTC

Each RT shall consist of several specialists, including a minimum of one in each of the following disciplines: ICP extension, entomology, plant pathology, and weed science (Figure 8). A reasonable mix of specialists based on important crops in the region and importance of discipline in the region is provided (Table 18).

The RTs in cooperation with the NCPP Directorate shall develop regional plans for ICP involving the major crops and crop associates for each are. Each RT working with the Directorate shall develop an ICP Technology Package for the crops in its area based on the guidelines developed for the soybean insect pest management package (Annex G).

The Directorate shall visit each RT at least three (3) times each year to view project development and review project proposals.

RT leaders shall meet with the Directorate at least three (3) times each year at a central location to insure coordination among RTs.

Table 18. Composition of Regional ICP Teams

Region	ICP Extension	Entomol.	Plt. Path.	Weed Sci.	Total
Tarapoto	2	2	2	2	8
Lambayeque Valley	2	3	2	1	8
Mantaro Valley	1	1	2	1	5
Alto Huallaga	2	2	2	2	8
Canete Valley	2	3	2	1	8
Cajamarca	1	1	1	1	4
TOTALS	10	12	11	8	41

Each RT shall operate as a unit but shall divide its tasks according to commodity and discipline. The RT leader shall be responsible for RT continuity and direction.

The RT leaders shall be responsible for communicating problems related to research, technology transfer, and personnel to the Directorate, who in turn shall have the responsibility of summoning help from the National ICP Center or from short term consultants from outside Peru through CICP to help solve the difficulty.

ICP extension specialists for all RTs shall meet for two (2) days every two (2) months at a central location to review ICP implementation progress and share methods for overcoming implementation constraints. The ICP extension specialists shall adjust their technology packages during these meetings. The Director, one of his advisors, or the CICP Consultant shall be present at each extension specialists' meeting.

Written reports shall be prepared annually by each RT. The RT leader shall be responsible for the reports. The reports shall be sent to the Director who shall be responsible for preparing a brief substantive summary of all RT reports in English and Spanish. These summaries shall be distributed to all RTs and donor organizations prior to the annual meeting of the RTs and TF.

All members of all RTs and TF shall meet with the Director, CICP Consultant and advisors once (1) each year for five (5) days to present results and accomplishments of research and technology transfer programs and to discuss the coming year's activities.

Regional ICP Sites

In developing an integrated crop protection strategy for Peru, the concept of regional pilot projects is paramount. This concept entails a team approach by plant protection specialists from a variety of disciplines coordinating their efforts on the important crops in a specific area. Regional ICP teams should first itemize, through prior knowledge and review of the literature, the species of pests likely to be important for the various crops in the area (This has been done in Annex C). They must then develop interim ICP packages detailing when and how pest species can best be controlled in each crop.

While extension specialists are helping to implement these interim ICP packages at the grower level, researchers should begin to revise various aspects of the package: actual pest species involved, sampling methodologies, economic thresholds, and control recommendations. Included should be a concerted effort to determine the population dynamics of important pest and beneficial species in relation to crop phenologies and cropping sequences. These new data should then be used to update the ICP package.

Once the system is functioning well and the key pest species of various crops are known, research should focus on alternative methods of maintaining these pests below economic thresholds: biological control, breeding crops for resistance and tolerance to key pests, and manipulation of cultural practices. An example of such a program is herein included (Annex G). Inherent in the system is a feedback mechanism capable of relaying new and unsolved protection problems to researchers, usually via extension. The delivery system is the lifeline of any ICP program, and it would be unwise to implement an ICP program without serious consideration of a strong, viable extension component.

Peru, divided into three major geographic areas--the coast (coastal zone), the sierra (mountainous zone) and the selva (jungle zone)--is ideally suited for three pilot ICP projects. From our investigation of the multiple resources available at and constraints inherent in various possible sites, the following are suggested for representative pilot integrated crop protection sites: the *Mantaro Valley* of the central sierra, the *Tarapoto* area of the upper selva, the *Alto Huallaga* area of the upper selva, and the *Lambayeque Valley* of the northern coast. In addition, two sites would be excellent as backups: the *Canete Valley* of the south central coast and the Cajamarca region of the northern sierra. Only the three primary sites will be discussed here.

Mantaro Valley (Huancayo)

The Mantaro Valley exists within the Andes Mountains and the city of Huancayo is its major commercial center. This site typifies agriculture in the sierra. Only the river valley aluvium contains rich soil and provides the possibility of irrigation during the dry season. Here, an abundance of vegetable crops are grown. The areas beyond the influence of the river aluvium generally have poor soils and a short growing season. While potatoes, corn and vegetables occupy the richer land, small grains (largely barley and wheat) occupy the poorer. In both the irrigated and non-irrigated areas,

diseases are the major concern. This valley is the primary site of the potato DPN and considerable work will be accomplished here for the small grains DPN.

Tarapoto

The Tarapoto area is a large tropical valley that typifies agriculture in the upper selva. Slash and burn agriculture is still practiced over much of the area. It is the national headquarters for the rice and corn DPN's; thus it will have a large staff of trained agronomists. It is not close to any functioning universities, thus student projects and student help will be difficult to attract. The soils are moderately fertile and the road network make communication and transport less difficult than in most other selva zones.

Lambayeqye Valley (Chiclayo)

The Lambayeque Valley is in the northern coastal zone, and crop production is heavily dependent on timely rainfall in the mountains to the east. In years when rainfall is scarce, very little is planted. Water, then, is a primary driving variable to crop production in the area. Several crops are grown in the Lambayeque Valley including grain legumes (principally beans and some soybean), flooded rice, and some corn. Another major agricultural product of the region is cotton. The area is fortunate to have a very active, enthusiastic contingent of crop protection specialists, some located at the Universidad Nacional Pedro Ruiz Gallo in Lambayeque and others located at the Vista Florida Experiment Station, CIPA II, INIPA, near Chiclayo. Researchers from these two institutions collaborate on several pest-related projects. CIPA II has initiated a small ICP project on cotton and other crops in the valley, and this has given the scientists and growers a feel for ICP. One of the extension personnel has already specialized in plant protection. Together, the team puts out weekly newspaper articles on pest control (Figure 2). Moreover, the National Grain Legume Program (DPN) is headquartered at CIPA II, Chiclayo. The loan from the World Bank (World Bank 1981) will focus on agriculture production in the northern area of Peru, and Chiclayo will serve as regional center. Thus, for a coastal area, the Lambayeque Valley has many advantages as a pilot site for an ICP program.

Crop protection in this area can be characterized as having severe insect problems, moderate disease and nematode problems, and minor weed problems. Large amounts of pesticides are used in the area, mainly for controlling insect pests, and these chemicals constitute a large expenditure on the part of growers. All too often excess amounts of pesticides are applied at improper times for control. The impact of an ICP program in the Lambayeque Valley should be aimed, among other aspects, at lowering the quantities of broad-spectrum pesticides used by growers.

Alto Huallaga (Tingo Maria)

The Alto Huallaga encompasses a large expanse of high jungle with up to 4000 mm of rainfall annually. Rivers have adequate water during the dry season to irrigate huge tracts of land. Water is not limiting in this region. Instead, a multitude of pest species, especially weeds, constitute major constraints to crop production. The area is being developed for perennial trees (cacao, coffee, citrus, banana) and flooded rice (rotated with grain legumes, principally soybean). Some corn is also grown in the region.

The major university of the jungle-zone, Universidad Nacional Agraria de la Selva (UNAS) is located in the Alto Huallaga area at Tingo Maria. Although poorly equipped and only moderately well funded, its professional crop protection staff are of excellent caliber. It also has adequate facilities available to house various aspects of an ICP program. It, however, has no land upon which to conduct field experiments. In contrast, the Agricultural Experiment Station at Tulumayo, INIPA has large tracts of land that are currently all but abandoned. This land contains valuable germplasm collections of many perennial crops. It is very poorly staffed, with only two professionals currently on location. The impending Special Project of the Alto Huallaga (AID/Peru 1981) will rebuild much of the experiment station and develop needed infrastructure for agriculture and agricultural commodities. It will also provide the needed professional staff at Tulumayo in plant protection. One of the many aspects of the area that needs shoring up is extension. Only a few extension staff are located in the region.

The plant protection problems in the Alto Huallaga are staggering. Weeds constitute the biggest challenge, but insects, diseases, nematodes and vertebrate pests are also very important. A balanced team is needed in this region, one that can use the expertise and students of the UNAS together with the growing involvement of INIPA.

Project Personnel Training

All identified RT & National ICP Center members shall undergo a two (2) week intensive refresher course at UNA at project initiation.

Technology transfer specialists shall remain for a third week to receive intensive training in crop extension, innovations in scouting, communications technology, and the T & V system of extension.

Each member of the RTs and all extension personnel should attend pesticide safety short courses.

Not less than two (2) regional workshops shall be organized by extension specialists each year in each region. The workshops shall concentrate on information transfer and shall include participation of Peritos Agricolas, interested growers, and pesticide industry administrators and salespersons.

Program Retraining

UNA has recently developed a comprehensive M.S. program for upgrading the level of extension specialists. It also has excellent B.S. and M.S. level curricula for many of the plant protection disciplines. We strongly suggest that a massive campaign be initiated to retrain the personnel now employed by INIPA, not only in the research but in the extension areas as well. UNA has the stature and ability to abosrb a large number of those scientists and we suggest that beginning immediately as many as 15 retrainees per year be placed in various UNA protection curricula. A list of those curricula is given in Annex E.

Program Training

Listed below (Table 19) are the M.S. and Ph.D. degree needs by discipline for the first five (5) years of this project. All graduates shall be incorporated into the program through one organization or another (INIPA, UNA, and the various participating national universities).

Building An International Reputation

The implementation of a comprehensive ICP program in Peru such as the one outlined herein would serve as a model for developing countries throughout the world. Because of the similarity of cropping systems and pest problems in many Latin American countries, upgrading facilities and human resources at the Universidad Nacional Agraria, La Molina (UNA) will place UNA in a position to attract students from several Latin American countries, especially Andean. UNA would gain regional recognition and could serve as the focal center of expertise in ICP training. INIPA would also gain international recognition through the implementation of such a program.

Budgetary Considerations

Although tentative and partial budgets have been formulated for this program, we feel that the intimate details needed to construct a realistic budget must await the next step in the development of this program. We have purposely left the crude budgets out of this report because we were unwilling to prejudice the following steps. If persons are interested in obtaining copies of these, they are advised to contact the senior author.

Table 19. Degree training for program.

EDUCATION ABROAD

Ph.D. Level	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Plant Pathology	-	-	-	1	-	1
Entomology	-	-	1	-	-	1
Weed Science	1	-	-	-	-	1
Nematology	-	1	-	-	-	1
Vertebrate Pest Sci.	-	-	-	-	1	1
TOTAL	1	1	1	1	1	5

M.S. Level	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Weed Science	1	-	2	-	-	3
Vertebrate Pest Sci.	1	1	-	-	-	2
Crop Protection Specialist	1	1	-	-	-	2
TOTAL	3	2	2	0	0	7

EDUCATION AT UNA

M.S. Level	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Plant Pathology	-	-	1	1	2	4
Virology	-	1	1	1	-	3
Entomology	-	-	1	2	2	5
Nematology	-	2	-	1	1	4
TOTAL	0	3	3	5	5	16

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ANNEX A

INSTITUTIONS AND PERSONS CONTACTED

INSTITUTIONS AND PERSONS CONTACTED

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ANNEX B

CROP LOSSES DUE TO PESTS IN PERU

Table 20 . Losses in thousands of US dollars for selected crop in Peru due to birds and rodents in 1976.

Table 21 . Estimate of losses due to insect pest damage of the principal crops of Peru during the 1971 growing season.

Table 22 . Losses due to nematodes of the principle crops of Peru during the 1967 growing season.

Table 23 . Losses due to disease (virus, mollecutes, fungi, and bacteria) of the principal crops of Peru during the 1967 growing season.

Table 24 . Losses due to weeds of the principal crops of Peru during the 1967 growing season.

Table 20 . Losses in thousands of dollars for selected crops in Peru due to birds and rodents for 1976.

	Birds	Rodents	Vertebrates
Cereals	1,510	1,200	2,710
Fruits	310	310	620
Pastures (alfalfa, others)	400	---	400
TOTALS	2,830	1,510	4,340

Source: Direccion de sanidad Vegetal, Ministerio de Alimentacion. Losses given in thousands of dollars.

Table 21. Estimate of losses due to insect pest damage of the principal crops of Peru during the 1971 growing season.

CROPS	% Damage	Losses in Has.	Losses in M.T.	Loss Value in 1000 US$
Potato	20	64,010	393,572	21,254
Corn	20	74,169	123,273	10,834
Grain legumes	20	18,593	15,178	2,966
Rice	2	2,946	11,822	1,433
Small grains	1	3,213	2,810	234
Cotton	33	44,987	76,800	22,221
Forage	20	29,731	1,350,880	17,583
Banana	30	19,834	275,706	8,553
Sugarcane	5	4,195	415,472	2,083
Apples, grapes	10	1,972	16,142	1,705
Peaches, mangos	30	1,659	18,000	1,503
Citrus	11	2,531	32,319	1,443
Coffee	2	2,463	1,411	550
TOTAL		270,303	2,733,385	92,363
Percentage		14.4%	13.4%	16.4%

Source: Sarmiento, Jorge. 1974.

Table 22. Losses due to diseases (viruses, mollecutes, fungi, and bacteria) of the principal crops of Peru during the 1967 growing season.

CROPS	Area (Has)	Production (Metric tons)	Value in 1000 US$	Losses by diseases Tons	%	crop loss due to disease in 1000 US$
Cotton	181,135	264,319	49,243	13,215	5	2,412
Rice	106,690	461,420	35,535	23,071	5	1,776
Potato	271,895	1'711,741	52,409	427,935	25	13,102
Sugarcane	98,613	8,433,150	30,211	42,165	0.5	163
Corn	386,735	710,305	42,089	21,309	3	1,262
Coffee	111,633	52,753	12,757	2,637	5	637
Grain legumes	167,770	195,072	17,982	19,507	10	1,798
Vegetables	59,570	1'018,458	20,712	50,922	5	1,035
Cereales	344,970	324,627	19,133	64,925	20	3,826
Tomato	5,815	64,802	2,947	12,690	20	589
Peppers	3,765	17,223	1,254	3,444	20	250
Citrus	21,179	269,708	8,716	67,427	25	2,179
Banana	60,675	832,270	24,561	208,067	25	6,140
Grape	9,244	53,879	4,958	5,389	10	495
Cocco	4,909	2,295	455	459	20	91
Alfalfa	124,870	6'010,215	52,409	300,510	5	2,620
Other pastures	153,460	1'754,110	5,859	35,082	2	117
Other fruits	38,130	356,825	15,744	17,841	5	787
Other Crops	163,239	1'844,300	82,609	73,772	4	3,304
	2'314,597	24'377,472	482,609	1,390,637		42,642

Source: Arevalo Diaz, J. 1973a.

Table 23. Losses due to nematodes of the principal crops of Peru, 1967 growing season.

CROPS	Area (Has)	Production (Metric tons)	Value in 1000 US$	Losses by nematodes Tons	%	crop loss due to disease in 1000 US$
Cotton	181,135	264,319	42,411	26,431	10	4,924
Potato	15,600	204,050	7,959	10,202	5	397
Potato	256,295	1'427,080	54,585	285,416	20	10,917
Coffee	111,633	72,753	12,757	3,637	5	637
Sugarcane	82,890	7'942,800	30,681	238,284	3	920
Tomato	5,815	64,802	2,947	7,796	12	353
Beans	77,650	76,457	8,398	11,468	15	1,259
Grains	8,385	6,992	1,217	699	10	121
Olive	3,870	9,710	2,924	184	2	58
Grape	9,244	53,879	4,958	4,310	8	396
Tobacco	4,825	4,971	1,725	248	5	86
Banana	60,675	832,270	24,561	83,227	10	2,456
Cocco	4,909	2,295	453	114	5	22
Vegetables	50,570	1'018,458	20,712	50,922	5	1,035
Alfalfa	124,870	6'010,215	52,409	120,204	2	1,048
Rice	106,190	461,420	35,535	-	-	-
Corn	386,735	710,305	42,089	-	-	-
Cereales	344,970	324,627	18,908	-	-	-
Other fruits	38,130	356,825	15,744	17,941	5	787
Other pastures	153,460	1'754,110	5,859	-	-	-
Other crops	163,239	1'844,300	82,609	-	-	-

Source: Arevalo Diaz, J. 1973b.

Table 24. Losses due to weeds of the principal crops of Peru during the 1967 growing season.

CROPS	Area (Has)	Production (Metric tons)	Losses by weeds		crop loss due to disease in 1000 US$
			Tons	%	
Cotton	181,135	264,319	49,243	2	132
Rice	106,690	461,420	35,535	10	1,153
Potato	271,895	1'711,741	52,409	5	3,139
Sugarcane	98,813	8'433,150	32,711	1	210
Corn	386,735	710,305	42,089	6	1,065
Coffee	111,633	52,753	12,757	5	65
Grain Legumes	167,770	195,072	17,982	6	292
Vegetables	59,570	1'018,458	20,962	8	2,036
Cereales	344,970	320,627	19,133	10	811
Tomato	5,815	64,802	2,947	5	81
Peppers	3,765	17,223	1,254	5	215
Citrus	21,179	269,708	8,716	2	134
Banana	60,675	832,270	24,561	1	208
Grape	9,244	53,879	4,958	1	13
Cocco	4,909	2,295	455	1	.55
Alfalfa	124,870	6'010215	52,409	10	15,025
Other pastures	153,460	1'754,110	5,859	5	2,192
Other fruits	38,130	356,825	15,744	2	178
Other crops	163,239	1'844,300	82,609	3	1,383

Source: Sanchez, D. 1973

ANNEX C

PESTS OF CROPS OF SELECTED REGIONS OF PERU

Table 25. Important pests of major perennial food crops of the upper selva at Tarapoto.

Table 26. Important pests of major crops of the upper selva at Alto Huallaga (Tingo Maria).

Table 27. Important pests of major crops of the coast in the Lambayeque Valley.

Table 28. Important pests of major crops of the sierra at Montero Valley (Huancayo).

Table 29. Important pests of major crops of the coast in the Canete Valley.

Table 30. Important pests of major crops of the sierra at Cajamarca.

Table 25. Important pests of major crops of the upper selva at Tarapota.

UPPER SELVA: TARAPOTO

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
RICE		
Vertebrates		
Sporophila spp.	Seedeaters	5
Oryzomys spp.	Rice Rats	5
Columbina sp.	Dove	2
Zonotrichia caponis	Rufous-collared sparrow	1
Nothoprocta sp.	Tinamous	1
Rhipidomys sp.	Climbing mice	1
Insects		
Sogatodes orizicola	Rice delphacid	4
Calandra oryzae	Rice weevil (storage)	3
Sitotroga cerealella	Angoumois grain moth (storage)	3
Nyctelius nyctelius	Leaf roller	3
Diatrea saccharalis	Sugarcane borer	1
Orthezia graminis	White scale	1
Nematodes		
Meloidogyne graminicola	Root-knot nematode	5
Hirschmanniella sp.	Rice root nematode	4
Aphelenchoides besseyi	Foliar nematode	4
Pratylenchus spp.	Lesion nematode	2
Criconemoides spp.	Ring nematode	1
Helicotylenchus spp.	Spiral nematode	1
Tylenchorhynchus spp.	Stunt nematode	1
Viruses and Diseases		
Piricularia oryzae	Rice blast	5
Helminthosporium oryzae	Brown spot	4
Hoja blanca	Virus	4
Rhynchorporium oryzae		3
Xanthomonas oryzae		2
Ushlaginoidea virens		1
Weeds		
Echinocloa crus-galli	Barnyard grass	5
Echinocloa colonum	Jungle rice	4
Ischaenum rugosum		4
Leptochloa uninervia	Mexican sprangle top	3
Cyperus difformis	Small flower umbrella plant	3

UPPER SELVA: TARAPOTO (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
MAIZE		
Vertebrates		
Oryzomys spp.	Rice rats	4
Aratinga sp.	Parakeet	3
Phyllotis sp.	Leaf-eared mouse	3
Mimus longicaudatus	Long-tailed mockingbird	2
Columba spp.	Pigeons-doves	2
Sigmodon sp.	Cotton rat	2
Sciurus sp.	Squirrel	2
Rattus spp.	Norway & Black rat	1-3
Mus musculus	House mouse	1-3
Nothoprocta sp.	Tinamous	1
Insects		
Spodoptera frugiperda	Fall armyworm	5
Diatrea saccharalis	Sugarcane borer	3
Elasmopalpus lignosellus	Lesser cornstalk borer	3
Heliothis zea	Corn earworm	2
Feltia sp.	Cutworm	2
Spodoptera sp.	Armyworm	2
Diabrotica spp.	Corn rootworms	2
Cerotoma spp.	Bean leaf beetles	2
Nematodes		
Pratylenchus spp.	Lesion nematode	4
Paratrichodorus spp.		4
Meloidogyne spp.	Root-knot nematode	3
Tylenchorhynchus spp.	Stunt nematode	1
Helicotylenchus spp.	Spiral nematode	1
Rotylenchus spp.	Sprial nematode	1
Criconemoides spp.	Ring nematode	1
Viruses and Diseases		
Corn stunt	Spiroplasma	4
Maize mosaic	Virus	4
Maize stripe	Virus	2
Maize rayado fino	Virus	2
Weeds		
Echinochloa crus-galli	Barnyard grass	4
Echinochloa colonum	Jungle rice	3
Cyperus rotundus	Umbrella plant	3
Ipomea spp.	Morning glory	2
Sida spp.	Sida	1

UPPER SELVA: TARAPOTO (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
SOYBEANS		
Vertebrates		
Zenaida ausiculata	Eared dove	3
Columba spp.	Pigeons-doves	2
Rhipidomys sp.	Climbing mouse	1
Insects		
Piezodorus guildinii	Stink bug	5
Anticarsia gemmatalis	Velvetbean caterpillar	4
Cerotoma arcuata	Bean leaf beetle	4
Pseudoplusia includens	Soybean looper	3
Acrosternum spp.	Stink bug	2
Nematodes		
Meloidogyne spp.	Root-knot nematode	4
Pratylenchus spp.	Lesion nematode	2
Helicotylenchus spp.	Spiral nematode	2
Xiphinema spp.	Dagger nematode	1
Criconemoides spp.	Ring nematode	1
Rotylenchulus spp.		1
Paratylenchus spp.	Pin nematode	1
Tylenchorhynchus spp.	Stunt nematode	1
Viruses and Diseases		
Cercospora kikuchii		4
Macrophomina phaseoli		3
Phytophthora sojae		3
Soybean mosaic	Virus	3
Peronospora manshurica	downy mildew	1
Weeds		
Echinochloa crus-galli	Barnyard grass	4
Echinochloa colonum	Jungle rice	3
Cyperus rotundus	Umbrella plant	3
Ipomea spp.	Morning glory	2
Sida spp.	Sida	1

Table 26. Important pests of the major perennial crops of the upper selva at Alto Huallaga (Tingo Maria).

UPPER SELVA: ALTO HULLAGA

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
CITRUS		
Vertebrates		
Mimus longicaudatus	Long-tailed mockingbird	5
Turdus chiguanco	Chiguanco thrush	2
Aratinga sp.	Parakeet	2
Pionus menstrus	Blue-headed parrot	2
Insects		
Ceratitis capitata	Mediterranean fruit fly	4
Anostrepha fraterculus	Fruit fly	4
Aphis citricola	Spirea aphid	4
Toxoptera aurantii	Black citrus aphid	4
Phyllocoptruta oleivora	Citrus rust mite	4
Aleurotrixus floccosus	Woolly whitefly	2
Lepidosaphes beckii	Purple scale	2
Pinnaspis aspidistrae	Fern scale	2
Papilio thoas	Swallowtail butterfly	2
Panonychus citri	Citrus red mite	2
Coccus hesperidum	Brown soft scale	2
Saissetia coffeae	Hemispherical scale	2
Trigona spp.		2
Nematodes		
Tylenchulus semipenetrans		5
Radopholus similis	Burrowing nematode	5
Pratylenchus spp.	Lesion nematode	2
Meloidogyne spp.	Root-knot nematode	2
Xiphinema spp.	Dagger nematode	1
Criconemoides spp.	Ring nematode	1
Helicotylenchus spp.	Spiral nematode	1
Rotylenchus spp.	Spiral nematode	1
Tylenchorhynchus spp.	Stunt nematode	1
Viruses and Diseases		
Tristeza	Virus	5
Phytophthora parasitica		4
Rhizoctonia solani		1
Weeds		
Cenchrus echinatus	Southern sandbur	3
Eleusine indica	Goosegrass	3
Digitaria sanguinalis	Large crabgrass	3
Rottboellia exaltata	Itchgrass	3
Euphorbia sp.	Spurge	3

UPPER SELVA: ALTO HUALLAGA (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
CITRUS (Continued)		
Weeds (Continued)		
Bidens pilosa	Hairy beggarticks	3
Eclipta alba		3
Commelina sp.	Dayflower	3
Andropogon sp.		2
Cyperus ferax		2
Paspalum conjugatum	Sour paspalum	2
Physallis angulata	Groundcherry	2
Pteridium aquilinum	Eastern bracken	2
Stellaria media	Chickweed	2
Paspalum virgatum		2
Croton sp.		1
CACAO		
Vertebrates		
Sciurus spp.	Squirrel	2
Insects		
Monalonion dissimulatum		5
Atta caphalotas	Leafcutting ant	3
Parajalysus pinosus		2
Selenothrips rubrocinctus	Redbanded thrips	2
Planococcus citri	Citrus mealybug	1
Planococcus brevispes		1
Nematodes		
Xiphinema spp.	Dagger nematode	3
Pratylenchus spp.	Lesion nematode	2
Meloidogynze spp.	Root-knot nematode	2
Radopholus similis	Burrowing nematode	2
Tylenchorhynchus spp.	Stunt nematode	1
Helicotylenchus spp.	Spiral nematode	1
Paratrichodorus spp.		1
Paratylenchus spp.	Pin nematode	1
Rotylenchus reniformis	Reniform nematode	1
Viruses and Diseases		
Phytophthora palmivora		5
Marasumius perniciosus		5
Rosellinia bonodes		4

UPPER SELVA: ALTO HUALLAGA (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
CACAO (Continued)		
Viruses and Diseases (Continued)		
Phomopsis sp.		2
Diplodia sp.		1
Colletotrichum sp.		1
Weeds		
Cenchrus echinatus	Southern sandbur	3
Eleusine indica	Goosegrass	3
Digitaria sanguinalis	Large crabgrass	3
Rottboellia exaltata	Itchgrass	3
Euphorbia sp.	Spurge	3
Bidens pilosa	Hairy beggarticks	3
Eclipta alba		3
Commelina sp.	Dayflower	3
Andropogon		2
Cyperus ferax		2
Paspalum conjugatum	Sour paspalum	2
Physallis angulata	Groundcherry	2
Pteridium aquilinum	Eastern bracken	2
Stellaria media	Chickweed	2
Paspalum virgatum		2
Croton sp.		
COFFEE		
Vertebrates		
Pionus menstrus	Blue-headed parrot	2
Insects		
Hypothenemus hampei	Coffee Borer	5
Leucoptera coffella		4
Coccus viridis	Green scale	3
Saissetia coffeae	Hemispherical scale	2
Toxoptera aurautii	Black citrus aphid	2
Araecerus fasiculatus	Coffee bean weevil	1
Nematodes		
Meloidogyne exigua	Root-knot nematode	5
Meloidogyne incognita	Root-knot nematode	5
Pratylenchus coffeae	Lesion nematode	4
Xiphinenia spp.	Dagger nematode	2

UPPER SELVA: ALTO HUALLAGA (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
COFFEE (Continued)		
Nematodes (Continued)		
Radopholus similis	Burrowing nematode	2
Tylenchorhynchus spp.	Stunt nematode	1
Helicotylenchus spp.	Spiral nematode	1
Paratylenchus spp.	Pin nematode	1
Viruses and Diseases		
Hemileia vastatrix	Yellow rust	5
Omphalia flavida		4
Pellicularia koleroga	Thread blight	4
Cercospora coffeicola	Brown spot	3
Colletotrichum coffeanum	Colletotrichum dieback	3
Rosellinia bunodes	Secondary root rot	2
Rhizoctonia solani	Damping off	1
Weeds		
Cenchrus echinatus	Southern sandbur	3
Eleusine indica	Goosegrass	3
Digitaria sanguinalis	Large crabgrass	3
Rottboelia exaltata	Itchgrass	3
Euphorbia sp.	Spurge	3
Bidens pilosa	Hairy beggarticks	3
Eclipta alba	Eclipta	3
Croton sp.	Croton	3
Commelina sp.	Dayflower	3
Andropogon		2
Cyperus ferax		2
Paspalum conjugatum	Sour paspalum	2
Physalis angulata	Groundcherry	2
Pteridium aquilinum		2
Stellaria media	Chickweed	2
Paspalum virgatum		2
BANANA		
Vertebrates		
None		
Insects		
Cosmopolites sordidus	Banana root borer	5
Metamasius sp.	Weevil	2
Castula licus		1

UPPER SELVA: ALTO HUALLAGA (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
BANANA (Continued)		
Insects (Continued)		
Caligo teucer		1
Nematodes		
Radopholus similis	Burrowing nematode	5
Pratylenchus spp.	Lesion nematode	2
Helicotylenchus spp.	Spiral nematode	2
Meloidogyne spp.	Root-knot nematode	2
Tylenchorhynchus spp.	Stunt nematode	1
Xiphinema spp.	Dagger nematode	1
Paratylenchus spp.	Pin nematode	1
Viruses and Diseases		
Pseudomonas solanacearum	Bacterial wilt	5
Mycosphaerella musicola	Sigatoka	4
Gleosporium musarum	Black end	3
Cordana musae	Leaf spot	2
Stachlydium theobromae		1
Weeds		
Cenchrus echinatus	Southern sandbur	3
Eleusine indica	Goosegrass	3
Digitaria sanguinalis	Large crabgrass	3
Rottboelia exaltata	Itchgrass	3
Euphorbia sp.	Spurge	3
Croton sp.		3
Bidens pilosa	Hairy beggarticks	3
Eclipta alba		3
Commelina sp.	Dayflower	3
Andropogon sp.		2
Cyperus ferax		2
Paspalum conjugatum	Sour paspalum	2
Physalis angulata	Groundcherry	2
Pteridium aquilinum	Eastern bracken	2
Stellaria media	Chickweed	2
Paspalum virgatum		2

Table 27. Important pests of major crops of the coast in the Lambayeque Valley.

COAST: VALLE DE LAMBAYEQUE

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
RICE		
Vertebrates		
Oryzomys spp.	Rice rats	5
Sporophila spp.	Seedeaters	5
Zenaida curriculata	Eared dove	3
Columa spp.	Pigeons-doves	2
Sturnella ballicosa	Peruvian red-breasted meadowlark	2
Scotinomys mollis	Field mice	1
Insects		
Sogatodes oryzicola	Rice delphacid	4
Diatraca saccharalis	Sugarcane borer	3
Spodoptera frugiperda	Fall armyworm	2
Nyctelius nyctelius	Leaf roller	2
Orthezia paragraminis	White scale	2
Nematodes		
Meloidogyne graminicola	Root-knot nematode	5
Aphelenchoi des besseyi		4
Hirschmanniella spp.		4
Pratylenchus spp.	Lesion nematode	2
Tylenchorhynchus spp.	Stunt nematode	1
Criconemoides spp.	Ring nematode	1
Helicotylenchus spp.	Spiral nematode	1
Viruses and Diseases		
Pirirularia oryzae	Rice blast	4
Bipolaris oryzae		4
Lephorphaeria salvinii		3
Neovosia horvida		2
Ustilaginoidea virens		2
Ophiofolus oryzinus		2
Hoja blanca	Virus	1
Xanthomonas oryzae		1
Rhynchorponum oryzae		1
Rhizoctonia solani		1

COAST: VALLE DE LAMBAYEQUE (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
RICE (Continued)		
Weeds		
Echinochloa crusgalli	Barnyard grass	5
Echinocholoa colonum	Jungle rice	4
Leptochloa uninervia	Mexican sprangle top	3
Cyperus difformis	Smallflower umbrella plant	3
Ischaenum rugosum		2
Cyperus sp.	Nutsedge	2
Jussiaea sp.	Water primrose	1
Heteranthera reniformis	Mud plantain	1
Eleocharis sp.	Spikcrush	1
Scirpus sp.	Bulrush	1
MAIZE		
Vertebrates		
Oryzomys spp.	Rice rats	4
Aratinga sp.	Parakeet	3
Rattus spp.	Norway & Black rats	1-3
Mus musculus	House mouse	1-3
Mimus longicaudatus	Long-tailed mockingbird	2
Zonotrichia caponsis	Rufous-collared sparrow	1
Insects		
Spodoptera frugiperda	Fall armyworm	5
Diatraea saccharalis	Sugarcane borer	5
Elasmopalpus lignosellus	Lesser cornstalk borer	4
Feltia experta		3
Feltia subterranea	granulate cutworm	3
Heliothis zea	Corn earworm	3
Pococera atramentalis		2
Diabrotica decolor		2
Frankliniella williamsi		2
Dalbulus maidis		1
Nematodes		
Pratylenchus spp.	Lesion nematode	4
Paratrichodonus spp.		4
Meloidogyne spp.	Root-knot nematode	3
Tylenchorhynchus spp.	Stunt nematode	1
Helicotylenchus spp.	Spiral nematode	1
Rotylenchus spp.	Spiral nematode	1
Criconemoides spp.	Ring nematode	1

COAST: VALLE DE LAMBAYEQUE (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
MAIZE (Continued)		
Viruses and Diseases		
Maize chlorotic mottle	Virus	5
Maize mosaic	Virus	4
Maize rayado fino	Virus	3
Cercopsora sp.		3
Weeds		
Eclipta alba		1
Solanum nigrum	Black nightshade	3
Echinochloa colonum	Jungle rice	3
Amaranthus hybridus	Smooth pigweed	3
Portulaca oleracea	Common purslane	3
Sonchus oleraceus	Annual sowwhistle	3
Trianthema portulacastrum	Horse purslane	2
Chloris sp.	Rhodesgrass	2
Setaria verticillata	Bristly foxtail	2
Cenchrus echinatus	Southern sandbur	2
BEANS		
Vertebrates		
Oryzomys spp.	Rice rats	5
Scotinomys spp.	Field mice	1
Insects		
Empoasca kraemeri	Leafhopper	5
Pseudoplusia includens	Soybean looper	4
Epinotia aporema		4
Liriomyza huidobrensis	Pea leafminer	4
Diabrotica decimpunctata		3
Diabrotica decolor		3
Hedylepta indicata	Leafroller	3
Elasmopalpus lignosellus	Lesser cornstalk borer	3
Tetranychus urticae	Twospotted spider mite	2
Feltia spp	Cutworms	2

COAST: VALLE DE LAMBAYEQUE (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
BEANS (Continued)		
Nematodes		
Meloidogyne spp.	Root-knot nematode	5
Pratylenchus spp.	Lesion nemtaode	2
Helicotylenchus spp.	Spiral nematode	2
Xiphinema americanum	American dagger nematode	1
Criconemoides spp.	Ring nematode	1
Rotylenchulus spp.		1
Hemicycliophora spp.	Sheath nematode	1
Paratylenchus spp.	Pin nematode	1
Tylenchorhynchus spp.	Stunt nematode	1
Viruses and Diseases		
Bean common mosaic	Virus	5
Uromyces phaseoli	Rust	5
Fusarium spp.	Root rot	3
Rhizoctonia solani	Root rot	3
Solentum rolfsii		3
Macrophomina phaseoli		2
Oidium sp.		2
Alternaria sp.		1
Weeds		
Eclipta alba		1
Solanum nigrum	Black nightshade	3
Echinochloa colonum	Jungle rice	3
Amaranthus hybridus	Smooth pigweed	3
Portulaca oleracea	Common purslane	3
Sonchus oleraceus	Annual sowwhistle	2
Trianthema portulacastrum	Horse purslane	2
Chloris sp.	Rhodesgrass	2
Setaria verticillata	Bristly foxtail	2
Cenchrus echinatus	Southern sandbur	2
SOYBEANS		
Vertebrates		
Zenaida auriculata	Eared dove	3
Columba spp.	Pigeons-doves	2

COAST: VALLE DE LAMBAYEQUE (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
SOYBEANS (Continued)		
Insects		
Piezodorus guildinii	Stink bug	3
Cerotoma fascialis	Bean leaf beetle	4
Anticarsia gemmatalis	Velvetbean Caterpillar	4
Pseudoplusia includens	Soybean looper	4
Cryptophlebia sp.	Shoot and pod borer	3
Tetranychus urticae	Twospotted spider mite	4
Spodoptera sunia		3
Epinotia aporema	Shoot and pod borer	3
Laspeyresia leguminis	Shoot and pod borer	3
Acrosternum sp.	Stick bug	3
Poliphagothrasonermus latus	Mite	3
Spodoptera eridiana	Cutworm	3
Hedylepta indicata	Leaf tier	2
Nematodes		
Meloidogyne spp.	Root-knot nematode	4
Pratylenchus spp.	Lesion nematode	2
Rotylenchulus spp.		2
Xiphinema spp.	Dagger nematode	1
Helicotylenchus spp.	Spiral nematode	1
Tylenchorhynchus	Stunt nematode	1
Criconemoides spp.	Ring nematode	1
Paratylenchus spp.	Pin nematode	1
Viruses and Diseases		
Soybean mozaic	Virus	3
Rhizoctonia solani	Rhizoctonia root rot	2
Cercospora kikuchi	Purple spot	1
Weeds		
Eclipta alba		1
Solanum nigrum	Black nightshade	3
Echinochloa colonum	Jungle rice	3
Amaranthus hybridus	Smooth pigweed	3
Portulaca oleracea	Common purslane	3
Sonchus oleraceus	Annual sowwhistle	2
Trianthema portulacastrum	Horse purslane	2
Chloris sp.	Rhodesgrass	2
Setaria verticillata	Bristly foxtail	2
Cenchrus echinatus	Southern sandbur	2

Table 28. Important pests of major crops in the sierra at Montero Valley (Huancayo).

SIERRA: MANTARO VALLEY

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
MAIZE		
Vertebrates		
Oryzomys spp.	Rice rats	4
Aratinga sp.	Parakeet	3
Phylottis sp.	Leaf-eared mouse	3
Columba spp.	Pigeons-doves	2
Sciurus sp.	Squirrel	2
Rattus spp.	Norway & Black rats	1-3
Mus musculus	House mouse	1-3
Nothoprocta sp.	Tinamouse	1
Insects		
Heliothis zea	Corn earworm	5
Spodoptera frugiperda	Fall armyworm	4
Dalbulus maidis		3
Peregrinus maidis	Corn delphacid	3
Feltia spp.	Cutworms	3
Capitarsia thurbata	Cutworms	
Rhopalosiphum maidis	Corn leaf aphid	3
Diabrotica decolor		2
Euxesta annonae	Ear fly	2
Frankliniella wiliamsi		2
Pagiocerus frontalis		1
Nematodes		
Pratylenchus spp.	Lesion nematode	4
Paratrichodorus spp.		4
Tylenchorhynchus spp.	Stunt nematode	1
Helicotylenchus spp.	Spiral nematode	1
Rotylenchus spp.	Spiral nematode	1
Viruses and Diseases		
Maize rayado fino	Virus	5
Nutritional deficiencies		
Maize chlorotic mottle	Virus	3
Helminthosporium turcicum	Leaf blight	2
Puccinia sorghi	Rust	2
Cercospora sp.		1
Maize bushy stunt	Mycoplasma	1

SIERRA: MANTARO VALLEY (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
MAIZE (Continued)		
Weeds		
Raphanus raphanistrum	Wild radish	3
Brassica sp.	Wild mustard	3
Amaranthus hibridus	Smooth pigweed	3
Bidens pilosa	Hairy begarticks	3
Chenopodium murale	Nettleleaf goosefoot	3
Pennisetum clandestinum	Kikuyugrass	3
Sida sp.	Sida	2
POTATO		
Vertebrates		
Oryzomys spp.	Rice rats	4
Phyllotis sp.	Leaf-eared mouse	3
Nothoprocta sp.	Tinamous	1
Insects		
Premnotrypes sulturicalus		4
Phthorimaea operculella	Potato tuberworm	3
Copitarsia thurbata		3
Cerotoma spp		3
Epitrix spp.	Flea beetle	3
Myzus persicae	green peach aphid	3
Macrosiphum euphorbiae	Potato aphid	3
Peridroma spp.	Cutworm	2
Scrobipalpula absoluta		2
Stenoptycha spp.		2
Nematodes		
Globdua pallida		5
Pratylenchus spp.	Lesion nematode	4
Nacobbus aberrans		3
Ditylenchus destructor	Potato rot nematode	1
Helicotylenchus spp.	Spiral nematode	1
Rotylenchus spp.	Spiral nematode	1
Tylenchorhynchus spp.	Stunt nematode	1
Trichodorus sp.	Stubby-root nematode	1
Paratrichodorus sp.		1
Xiphinema spp.	Dagger nematode	1

SIERRA: MANTARO VALLEY (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
POTATO (Continued)		
Viruses and Diseases		
Phytophthora infestans	Late blight	5
Phytophthora erythroseptira		4
Fusarium sp.		3
Erwinia carotovora	Soft rot	3
Potato virus Y	Virus	3
Potato virus X	Virus	3
Erwinia carotovora var. *atroseptica*		3
Rhizoctonia solani	Black scurf	3
Spongorpora subterranea		3
Synchtrium endofrodicum		3
Verticillum aldo-atrum		1
Weeds		
Raphanus raphanistrum	Wild radish	3
Brassica sp.	Wild mustard	3
Amaranthus hibridus	Smooth pigweed	3
Bidens pilosa	Hairy beggarticks	3
Chenopodium murale	Nettleleaf goosefoot	3
Pennisetum clandestinum	Kikuyugrass	3
Bromus sp.	Brome	2
Sida sp.	Sida	2
BARLEY		
Vertebrates		
Columba spp.	Pigeons-doves	3
Phrygilus sp.	Sierra finch	2
Nothoprocta sp.	Tinamous	1
Insects		
Rhopalosiphum maidis	Corn leaf aphid	4
Metopolophium dirhodum		3
Spodoptera frugiperda	Fall armyworm	2
Diabrotica decolor		1
Nematodes		
Heterodera avenae		4
Pratylenchus spp.	Lesion nematode	3
Ditylenchus dipsaci	Stem nematode	3
Tylenchorhynchus spp.	Stunt nematode	1
Helicotylenchus spp.	Spiral nematode	1
Rotylenchus spp.	Spiral nematode	1

SIERRA: MANTARO VALLEY (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
BARLEY (Continued)		
Viruses and Diseases		
Puccinia striiformis	Rust	5
Barley yellow dwarf	Virus	4
Rhynchosporium secalis	Scald	3
Helminthosporium spp.		3-4
Puccinia graministritia		2
Ustilago nuda		
Ustilago hordei		2
Cladosponium		2
Weeds		
Raphanus raphanistrum	Wild radish	5
Brassica sp.	Wild mustard	5
Bromus sp.	Brome	4
Avena fatua	Wild oat	3
WHEAT		
Vertebrates		
Columba spp.	Pigeons-doves	3
Phrygilus spp.	Sierra finch	2
Nothoprocta spp.	Tinamous	2
Zonotrichia capensis	Rufous-collared sparrow	1
Insects		
Rhopalosiphum padi	Aphid	4
Nematodes		
Heterodera avenae		4
Pratylenchus spp.	Lesion nematode	3
Ditylenchus dipsaci	Stem nematode	3
Tylenchorhynchus spp.	Stunt nematode	1
Helicotylenchus spp.	Spiral nematode	1
Rotylenchus spp.	Spiral nematode	1

SIERRA: MANTARO VALLEY (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
WHEAT (Continued)		
Viruses and Diseases		
Puccinia striiformis	Rust	4
Barley yellow dwarf	Virus	4
Puccinia graminis tritici		3
Helminthosporium sativum		3
Ustilago tritici		2
Tilletia caries		2
Puccinia recondita tritici		2-3
Gibberella zea (Fusarium graminearum)		1-2
Erysiphe graminis tritici		1-2
Fusarium spp.		1-2
Weeds		
Raphanus raphanistrum	Wild radish	5
Brassica sp.	Wild mustard	5
Bromus sp.	Brome	4
Avena fatua	Wild oat	3

Table 29. Important pests of major food crops of the coast in the Canete Valley.

COAST: CANETE VALLEY

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
MAIZE		
Vertebrates		
Oryzomys spp.	Rice rats	4
Aratinga sp.	Parakeet	3
Phyllotis sp.	Leaf-eared mouse	3
Rattus spp.	Norway & Black rats	1-3
Mus musculus	House mouse	1-3
Mimus longicaudatus	Long-tailed mockingbird	2
Columba spp.	Pigeons-doves	2
Sciurus sp.	Tree squirrel	2
Zonotrichia capensis	Rufous-collared sparrow	1
Nothoprocta sp.	Tinamous	1
Scotinomys mollis	Field mice	1
Insects		
Spodoptera frugiperda	Fall armyworm	5
Diatraea saccharalis	Sugarcane borer	4
Elasmopalpus lignosellus	Lesser cornstalk borer	3
Feltia experta		3
Agrotis ipsilon	Black cutworm	3
Pococera atramentalis		2
Heliothis zea	Corn earworm	2
Frankliniella williamsi	Thrips	2
Peregrinus maidis		2
Dalbulus maidis		2
Orthotylellus carmelitanus		2
Nematodes		
Pratylenchus brachyurus	Lesion nematode	4
Paratrichodorus spp.		4
Meloidogyne spp.	Root-knot nematode	3
Criconemoides spp.	Ring nematode	1
Tylenchorhynchus spp.		1
Helicotylenchus spp.	Spiral nematode	1
Rotylenchus spp.	Spiral nematode	1
Viruses and Diseases		
Maize chlorotic mottle	Virus	3
Maize mosaic	Virus	3
Cercospora sp.		2
Helmenthospinium turcicum	Leaf blight	2
Nutritional deficiencies		2

COAST: CANETE VALLEY (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
MAIZE (Continued)		
Weeds		
Amaranthus hibridus	Smooth pigweed	3
Bidens pilosa	Hairy beggarticks	3
Chenopodium murale	Nettleleaf goosefoot	3
Datura stramonium	Jimsonweed	3
Euphorbia sp.	Spurge	3
Ipomea sp.	Morningglory	3
Nicandra physalodes	Apple-Peru	3
Portulaca oleracea	Common purslane	3
Solanum nigrum	Black nightshade	3
Cenchrus echinatus	Southern sandbur	3
Chloris sp.	Rhodesgrass	3
Eleusine indica	Goosegrass	3
Setaria verticillata	Bristly foxtail	3
Sorghum halepense	Johnsongrass	3
Sida sp.	Sida	2
Cynodon dactylon	Bermuda grass	2
BEANS		
Vertebrates		
Zenaida curciculata	Eared dove	3
Oryzomys spp.	Rice rats	3
Columba spp.	Pigeons-doves	2
Nothoprocta spp.	Tinamous	1
Insects		
Empoasca kraemeri	Leafhopper	5
Pseudoplusia includens	Soybean looper	4
Epinotia aporema		4
Liriomyza huidobrensis	Pea leafminer	4
Diabrotica decimpunctata		3
Diabrotica decolor		3
Hedylepta indicata	Leafroller	3
Elasmopalpus lignosellus	Lesser cornstalk borer	3
Tetranychus urticae	Twospotted spider mite	2
Feltia spp.	Cutworms	2
Nematodes		
Meloidogyne sp.	Root-knot nematode	5
Pratylenchus spp.	Lesion nematode	2
Helicotylenchus spp.	Spiral nematode	2
Rotylenchulus spp.		2
Xiphinema americanum	American dagger nematode	1

COAST: CANETE VALLEY (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
BEANS (Continued)		
Nematodes (Continued)		
Cucmenoides sp.		1
Pratylenchus spp.	Lesion nematode	1
Tylenchorhynchus spp.		1
Viruses and Diseases		
Rhizoctonia solani	Rhizoctonia root rot	2
Fusarium spp.		2
Phytophthora sojae		2
Cercospora kikuchi		1
Bean common mosaic	Virus	1
Weeds		
Amaranthus hibridus	Smooth pigweed	3
Bidens pilosa	Hairy beggarticks	3
Chenopodium murale	Nettleleaf goosefoot	3
Datura stramonium	Jimsonweed	3
Euphorbia sp.	Spurge	3
Ipomea sp.	Morningglory	3
Nicandra physalodes	Apple-Peru	3
Portulaca oleracea	Common purslane	3
Solanum nigrum	Black nightshade	3
Cenchrus echinatus	Southern sandbur	3
Chloris sp.	Rhodesgrass	3
Eleusine indica	Goosegrass	3
Setaria verticillata	Bristly foxtail	3
Sorghum halepense	Johnsongrass	3
Sida sp.	Sida	2
Cynodon dactylon	Bermuda grass	2
SOYBEANS		
Vertebrates		
Zenaida auriculata	Eared dove	3
Columba spp.	Pigeons-doves	2
Insects		
Piezodorus guildinii	Stink bug	3
Ceratoma fascialis	Bean leaf beetle	4
Anticarsia gemmatalis	Velvetbean Caterpillar	4
Pseudoplusia includens	Soybean looper	4
Cryptophlebia sp.	Shoot and pod borer	3
Tetranychus urticae	Twospotted spider mite	4
Spodoptera sunia		3
Epinotia aporema	Shoot and pod borer	3

COAST: CANETE VALLEY (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
SOYBEANS (Continued)		
Insects (Continued)		
Laspeyresia leguminis	Shoot and pod borer	3
Acrosternum sp.	Stick bug	3
Poliphagothrasonermus latus	Mite	3
Spodoptera eridiana	Cutworm	3
Hedylepta indicata	Leaf tier	2
Nematodes		
Meloidogyne spp.	Root-knot nematode	4
Pratylenchus spp.	Lesion nematode	2
Rotylenchulus spp.		2
Xiphinema spp.	Dagger nematode	1
Helicotylenchus spp.	Spiral nematode	1
Tylenchorhynchus	Stunt nematode	1
Criconemoides spp.	Ring nematode	1
Paratylenchus spp.	Pin nematode	1
Viruses and Diseases		
Soybean mozaic	Virus	3
Rhizoctronia solani	Phizoctonia root rot	2
Cercospora kikuchi	Purple spot	1
Weeds		
Eclipta alba		1
Solanum nigrum	Black nightshade	3
Echinochloa colonum	Jungle rice	3
Amaranthus hybridus	Smooth pigweed	3
Portulaca oleracea	Common purslane	3
Sonchus oleraceus	Annual sowwhistle	2
Trianthema portulacastrum	Horse purslane	2
Chloris sp.	Rhodesgrass	2
Setaria verticillata	Bristly foxtail	2
Cenchrus echinatus	Southern sandbur	2
POTATO		
Vertebrate Pests		
Oryzomys spp.	Rice rats	4
Phyllotis sp.	Leaf-eared mouse	4
Nothoprocta sp.	Tinamous	1
Insects		
Liriomyza kuidobrensis	Leafminer	5
Scrobipalpula absoluta		4
Pthorimaea operculella		4
Myzus persicae	Green peach aphid	4
Macrosiphum euphorbiae	Potato aphid	3
Pseudoplusia includens	Soybean looper	3

COAST: CANETE VALLEY (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
POTATO (Continued)		
Insects (Continued)		
podoptera eridania	Southern armyworm	3
Feltia experta	Cutworm	3
Polyphagotarsonemus latus	Broad mite	2
Prodiplosis sp.	Midge	2
Tetranychus urticae	Twospotted spider mite	1
Diabrotica decolor		1
Nematodes		
Meloidogyne spp.	Root knot nematode	5
Pratylenchus spp.	Lesion nematode	4
Rotylenchulus spp.		2
Ditylenchus destructor		1
Helicotylenchus spp.	Spiral nematode	1
Rotylenchus spp.	Spiral nematode	1
Tylenchorhynchus spp.		1
Paratrichodorus spp.		1
Trichodorus spp.	Stubby-root nematode	1
Xiphinema spp.	Dagger nematode	1
Viruses and Diseaes		
Phytophthora infestans	Late blight	5
Potato leafroll	Virus	4
Potato virus Y	Virus	4
Potato virus Y plus potato virus X	Virus	4
Verticillium alfo-atrum		3
Rhizoctonia solani	Black scurf	3
Angiosonus solani		2
Sclerotium rolfsii	Southern blight	1
Sclerotinia sclerotiorum	Drop rot	1
Oidium sp.		1
Weeds		
Amaranthus hibridus	Smooth pigweed	3
Bidens pilosa	Hairy beggarticks	3
Chenopodium murale	Nettleleaf goosefoot	3
Datura stromonium	Jimson weed	3
Euphorbia sp.	Spurge	3
Ipomea sp.	Morningglory	3

COAST: CANETE VALLEY (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
POTATO (Continued)		
Weeds (Continued)		
Nicandra physalodes	Apple of Peru	3
Portulaca oleracea	Common purslane	3
Solanum nigrum	Black nightshade	3
Cenchrus echinatus	Southern sandbur	3
Chioris sp.	Rhodesgrass	3
Eleusine indica	Goosegrass	3
Setaria verticillata	Bristly foxtail	3
Sorghum halepense	Johnsongrass	3
Cynodon dactylon	Bermuda grass	2
Sida sp.	Sida	2

Table 30. Important pests of major crops in the sierra at Cajamarca.

SIERRA: CAJAMARCA

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
MAIZE		
Vertebrates		
Oryzomys spp.	Rice rats	4
Aratinga sp.	Parakeet	3
Rattus spp.	Norway & Black rats	1-3
Mus musculus	House mouse	1-3
Columba spp.	Pigeons-doves	2
Sciurus sp.	Squirrel	2
Insects		
Heliothis zea	Corn earworm	5
Spodoptera frugiperda	Fall armyworm	4
Dalbulus maidis		3
Peregrinus maidis	Corn delphacid	3
Feltia spp.	Cutworms	3
Capitarsia thurbata	Cutworms	
Rhopalosiphum maidis	Corn leaf aphid	3
Diabrotica decolor		2
Euxesta annonae	Ear fly	2
Frankliniella williamsi		2
Pagiocerus frontalis		1
Nematodes		
Pratylenchus spp.	Lesion nematode	4
Paratrichodorus spp.		4
Tylenchorhynchus spp.	Stunt nematode	1
Helicotylenchus spp.	Spiral nematode	1
Rotylenchus spp.	Spiral nematode	1
Viruses and Diseases		
Maize rayado fino	Virus	5
Nutritional deficiencies		3
Maize chlorotic mottle	Virus	3
Helminthosporium turcicum	Leaf blight	2
Puccinia sorghi	Rust	2
Cercospora sp.		1
Maize bushy stunt	Mycoplasma	

SIERRA: CAJAMARCA (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
MAIZE (Continued)		
Weeds		
Raphanus raphanistrum	Wild radish	3
Brassica sp.	Wild mustard	3
Amaranthus hibridus	Smooth pigweed	3
Bidens pilosa	Hairy begarticks	3
Chenopodium murale	Nettleleaf goosefoot	3
Pennisetum clandestinum	Kikuyugrass	3
Sida sp.	Sida	2
POTATO		
Vertebrates		
Oryzomys spp.	Rice rats	4
Phyllotis sp.	Leaf-eared mouse	3
Nothoprocta sp.	Tinamous	1
Insects		
Premnotrypes fractirostris		3
Phthorimaea operculella	Potato tuberworm	3
Copitarsia thurbata		3
Cerotoma spp		
Diabrotica spp.		3
Ceratoma spp.	Bean leaf beetle	3
Myzus persicae	green peach aphid	3
Macrosiphum euphorbiae	Potato aphid	3
Feltia spp.	Cutworms	2
Scrobipalpula absoluta		2
Stenoptycha sp.		2
Nematodes		
Globodera pallida		5
Pratylenchus spp.	Lesion nematode	4
Nacobbus aberrans		3
Ditylenchus destructor	Potato rot nematode	1
Helicotylenchus spp.	Spiral nematode	1
Rotylenchus spp.	Sprial nematode	1
Tylenchus spp.		1
Trichodorus sp.	Stubby-root nematode	1
Paratrichodorus sp.		1
Xiphinema spp.	Dagger nematode	1

SIERRA: CAJAMARCA (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
POTATO (Continued)		
Viruses and Diseases		
Phytophthora infestans	Late blight	5
Pseudomonas solanacearum	Brown rot	4
Phytophthora erythroseptira		3
Fusarium sp.	Root rot	3
Erwinia carotovora	Soft rot	3
Rhizoctonia solani	Black scurf	2
Spongorspora subterranea		2
Synchytrium endofroticum		2
Phoma sp.		1
Septoria sp.		1
Potato virus X	Virus	1
Potato virus Y	Virus	1
Weeds		
Raphanus raphanistrum	Wild radish	3
Brassica sp.	Wild mustard	3
Amaranthus hibridus	Smooth pigweed	3
Bidens pilosa	Hairy beggarticks	3
Chenopodium murale	Nettleleaf goosefoot	3
Pennisetum clandestinum	Kikuyugrass	3
Bromus sp.	Brome	2
Sida sp.	Sida	2
WHEAT		
Vertebrates		
Columba spp.	Pigeons-doves	3
Phrygilus sp.	Sierra finch	2
Nothoprocta sp.	Tinamous	2
Zonotrichia capensis	Rupus-collared sparrow	1
Insects		
Rhopalosiphum padi	Aphid	4
Nematodes		
Heterodera avenae		4
Pratylenchus spp.	Lesion nematode	3
Ditylenchus dipsaci	Stem nematode	3
Tylenchorhynchus spp.	Stunt nematode	1
Helicotylenchus spp.	Sprial nematode	1
Rotylenchus spp.	Spiral nematode	1

SIERRA: CAJAMARCA (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
WHEAT (Continued)		
Viruses and Diseases		
Puccinia striiformis	Rust	4
Barley yellow dwarf	Virus	
Puccinia graminis tritici		3
Helminthosporium sativum		3
Ustilago tritici		2
Tilletia caries		2
Puccinia recondita tritici		2-3
Gibberella zea (Fusarium granimearum)		1-2
Erysiphe graminis tritici		1-2
Fusarium spp.		1-2
Weeds		
Raphanus raphanistrum	Wild radish	5
Brassica sp.	Wild mustard	5
Bromus sp.	Brome	4
Avena fatua	Wild oat	3
BARLEY		
Vertebrates		
Columba spp.	Pigeons-doves	3
Phrygilus sp.	Sierra finch	2
Nothoprocta sp.	Tinamous	1
Insects		
Rhopalosiphum maidis	Corn leaf aphid	4
Metopolophium dirhodum		3
Spodoptera frugiperda	Fall armyworm	2
Diabrotica decolor		1
Nematodes		
Heterodera avenae		4
Pratylenchus spp.	Lesion nematode	3
Ditylenchus dipsaci	Stem nematode	3
Tylenchorhynchus spp.	Stunt nematode	1
Helicotylenchus spp.	Spiral nematode	1
Rotylenchus spp.	Spiral nematode	1

SIERRA: CAJAMARCA (Continued)

SCIENTIFIC NAME	COMMON NAME	IMPORTANCE (1=low; 5=high)
BARLEY (Continued)		
Viruses and Diseases		
Puccinia striiformis	Yellow rust	5
Barley Yellow Dwarf	Virus	4
Helminthosporium spp.		3-4
Puccinia hordei	Stem rust	3
Puccinia graminis tritici	Brown rust	3
Rhynchosporium secalis		3
Ustilago nuda		2
Ustilago hordei		2
Alternaria sp.		2
Weeds		
Raphanus raphanistrum	Wild radish	5
Brassica sp.	Wild mustard	
Bromus sp.	Brome	4
Avena fatua	Wild oat	3

ANNEX D

LETTER FROM DR. KNUTSON TO DR. GONZALEZ CONCERNING INSECT IDENTIFICATIONS BY THE USDA FOR LATIN AMERICAN COUNTRIES

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

ANNEX E

SELECTED GRADUATE ACADEMIC PROGRAMS AT THE UNIVERSIDAD NACIONAL AGRARIA, LA MOLINA

Table 31. Entomology

Table 32. Plant Pathology

Table 33. Agronomy

Table 34. Plant Breeding

Table 35. Agricultural Economics

Table 36. Professors Responsible for the Advanced Courses

Source: Peru, Universidad Nacional Agraria, La Molina. 1981.

Table 31. Entomology

PROGRAMA ACADEMICO DE GRADUADOS
UNIVERSIDAD NACIONAL AGRARIA

ESPECIALIDAD DE ENTOMOLOGIA

La especialidad de Entomología está orientada a formar especialistas con una sólida preparación en aspectos básicos y aplicados de esta ciencia. Con tal fin el alumno graduado se capacita teórica y prácticamente en materias de la especialidad según su interés y con la orientación de su Comité Consejero. Al término de sus estudios, el Magister Scientiae en Entomología, está capacitado para realizar docencia a nivel universitario, programar y ejecutar investigaciones de laboratorio y de campo sobre problemas de la especialidad, trabajar en la industria y comercio de pesticidas, y efectuar labores de asesoramiento sobre el control de plagas.

Para ingresar a la Especialidad de Entomología se exige una adecuada formación en ciencias básicas y aplicadas; lo que generalmente se satisface con los curricula profesionales de Agronomía, Biología y profesiones afines. Los candidatos deben completar los requisitos señalados por la especialidad para ser aceptados como alumnos regulares.

Los alumnos tienen la obligación de llevar a cabo un proyecto de investigación bajo su responsabilidad personal con el asesoramiento de su Profesor Consejero. Este trabajo constituye su tesis de Grado. Aquellos alumnos con interés especial por la investigación tienen la oportunidad de participar en los proyectos de investigación que se conducen a nivel del Departamento de Entomología. Los trabajos suelen estar dentro de las áreas de biología, ecología, taxonomía, toxicología, protección de cultivos y entomología médica y veterinaria.

REQUISITOS DE CURSOS PARA LA OBTENCION DEL GRADO DE MAGISTER SCIENTIAE EN LA ESPECIALIDAD DE ENTOMOLOGIA

1. CURSOS NO GRADUADOS REQUISITOS PARA LA ADMISION

Entomología General
Estadística General
Biología General
Botánica General
Zoología General
Física General
Química General
Química Orgánica

2. CURSOS NO GRADUADOS OBLIGATORIOS NO REQUISITOS PARA LA ADMISION

Meteorología y Climatología
Entomología Agrícola
Principios de Control de Plagas
Crianza y Evaluación de Insectos

3. CURSOS GRADUADOS OBLIGATORIOS DEL CAMPO PRINCIPAL

Código	Cursos	Pre-requisitos	T-P-C
SV-712	Sistemática de Insectos I	Entomología General	2-2-3
SV-713	Sistemática de Insectos II	Sistemática de Insectos I	3-2-3
SV-711	Morfología de Insectos	Entomología General	2-2-3
SV-791	Seminario de Entomología I	Autorización delCComité	1
SV-792	Seminario de Entomología II	Autorización del Comité	1
SV-799	Investigación en Entomología	Autorización del Comité	1-6

4. CURSOS GRADUADOS ELECTIVOS DEL CAMPO PRINCIPAL

Código	Cursos	Pre-requisitos	T-P-C
SV-718	Control Integrado de Plagas	Principio de Control de Plagas Ecología de Insectos	2-1-3
SV-715	Anatomía y Fisiología de Insectos	Bioquímica I Morfología de Insectos	2-2-3
SV-713	Ecología de Insectos	Entomología General Ecología General	2-2-3
SV-611	Entomología Médica y Veterinaria	Entomología General, ó Enfermedades Parasitarias	2-1-3

Especialidad de Entomología

Código	Cursos	Pre-requisitos	T-P-C
SV-714	Insectos Inmaduros	Sistemática de Insectos I Sistemática de Insectos II	1-2-2
SV-741	Nemátodes Parásitos de Plantas	Nematología Fisiología Vegetal	2-2-3
SV-721	Toxicología	Principio de Control de Plagas, ó Crianza y Evaluación de Insectos	2-2-3
SV-795	Problemas Especiales en Entomología	Autorización del Comité	1-4

5. CURSOS GRADUADOS ELECTIVOS DEL CAMPO COMPLEMENTARIO

Areas Recomendables:

Fitopatología
Estadística

Significado de las abreviaturas:

T - Horas de teoría por semana

P - Horas de práctica por semana

C - Número de créditos

SYLLABI DE LOS CURSOS OFRECIDOS EN LA ESPECIALIDAD DE ENTOMOLOGIA

SV-715 ANATOMIA Y FISIOLOGIA DE INSECTOS (2-2) 3 cr.
Pre-requisitos: Bioquímica General
Morfología de Insectos

Estudio de los órganos internos y de las funciones vitales de los insectos: nutrición excresión, circulación, respiración, función sensorial, locomoción, reproducción y desarrollo.

SV-718 CONTROL INTEGRADO DE PLAGAS (2-1) 3 cr.
Pre-requisitos: Principio de Control de Plagas
Ecología de Insectos
Estudio de la aplicación de los conceptos ecológicos en el control de las plagas agrícolas mediante el análisis de los ecosistemas agrícolas y la integración de los métodos de control biológico, químico, cultural, ecológico y legal.

SV-713 ECOLOGIA DE INSECTOS (2-2-) 3 cr.
Pre-requisitos: Entomología General
Ecología General
Efecto de los factores de medio ambiente sobre el desarrollo, distribución y abundancia de los insectos.

SV-611 ENTOMOLOGIA MEDICA Y VETERINARIA (2-1) 3 cr.
Pre-requisitos: Entomología General, ó
Enfermedades Parasitarias

La Entomología Médica y Veterinaria es la ciencia que trata sobre la relación que tienen insectos arácnidos y otros artrópodos con condiciones patológicas en el hombre y animales, principalmente domésticos o de la transmisión por artrópodos de organismos responsables de dichas condiciones patológicas.

SV-714 INSECTOS INMADUROS (1-2) 2c3
Pre-requisitos: Sistemática de Insectos I
Sistemática de Insectos II

Estudio de las órdenes y principales familias en los estados inmaduros de los insectos

SV-741 NEMATODES PARASITOS DE PLANTAS (2-2) 3cr.
Pre-requisitos: Nematología
Fisiología Vegetal

Estudio taxonómico y biológico de los nemátodes que constituyen plagas en la agricultura, así como sus métodos de control.

SV-721 TOXICOLOGIA
Pre-requisitos: Principio de Control de Plagas, ó
Crianza y Evaluación de Insectos

Estudio de los insecticidas, su naturaleza química en relación a su toxicidad, modo de acción problemas de residuos, mecanismos de toxificación y resistencia. Evaluación de los insecticidas en el laboratorio y en el campo. Análisis estadístico de los datos.

Table 32. Plant Pathology

ESPECIALIDAD DE FITOPATOLOGIA

La Fitopatología es una ciencia dedicada al estudio de las enfermedades de las plantas, sus causas, proceso y control. Su propósito es desarrollar nuevos conocimientos a través de la investigación básica sobre las enfermedades de las plantas y aplicar estos conocimientos con el objeto de ayudar a satisfacer las siempre crecientes necesidades del hombre muy especialmente en alimentos de fibra. Es una ciencia multifacética que ofrece una gran diversidad de oportunidades científicas y profesionales cualquiera que sea la inclinación del estudiante ya sea a la botánica, micología, bacteriología, virología, fisiología vegetal, taxonomía, ecología, mejoramiento genético o entomología.

El estudiante en esta especialidad recibe una preparación teórica y práctica en materias seleccionadas por el Comité Consejero, según su propia inclinación, sin embargo al término de sus estudios de Magister Scientiae, deberá poseer un profundo conocimiento de conceptos fundamentales para poder desarrollarse con eficiencia en programas de enseñanza, investigación y extensión ya sea en Universidades, Instituciones Públicas o privadas del país o del extranjero.

Los postulantes deberán poseer una preparación adecuada en ciencias básicas y aplicadas a nivel universitario por lo que se exigen ciertos requisitos de cursos para la admisión. Asimismo, en casos necesarios los alumnos graduados se inscribirán en aquellos cursos no graduados que sean básicos para su formación integral.

El alumno graduado tiene la oportunidad de participar en la enseñanza de los diferentes cursos que ofrece la Especialidad, así como de realizar su investigación sobre problemas relacionados con los diferentes proyectos que se llevan a cabo, o en los programas de investigación en que participa la Especialidad.

REQUISITOS DE CURSOS PARA LA OBTENCION DEL GRADO DE MAGISTER SCIENTIAE EN LA ESPECIALIDAD DE FITOPATOLOGIA

1. CURSOS NO GRADUADOS REQUISITOS PARA LA ADMISION

Fitopatología	General
Biología	General
Bioquímica	General
Botánica	General
Estadística	General
Física	General
Fisiología	Vegetal
Genética	General
Química	General e Inorgánica

2. CURSOS NO GRADUADOS OBLIGATORIOS NO REQUISITOS PARA LA ADMISION

Botánica Sistemática
Ecología Agrícola
Entomología General
Fitopatología Agrícola
Meteorología y Climatología
Nematología
Química Orgánica
Métodos Estadísticos I

3. CURSOS GRADUADOS OBLIGATORIOS DEL CAMPO PRINCIPAL

Código	Cursos	Pre-requisitos	T-P-C
FI -601	Micología	Biología I	2-2-3
FI -761	Técnicas y Métodos de Fitopatología	Fitopatología General	3-2-4
FI -762	Hongos Fitopatógenos	Micología Fitopatología Agrícola	3-2-4
FI -763	Fitopatología Avanzada	Fitopatología Agrícola	3-2-4
FI -793	Seminario de Fitopatología I	Autorización del Comité	1
FI-794	Seminario de Fitopatología II	Autorización del Comité	1
FI-799	Investigación en Fitopatología		1-6

.../

Especialidad de Fitopatología

4. CURSOS GRADUADOS ELECTIVOS DEL CAMPO COMPLEMENTARIO

Código	Cursos	Pre-requisitos	T-P-C
FI-662	Control de las Enfermedades de las Plantas.	Fitopatología Agrícola	2-2-3
FI-764	Bacterias Fitopatógenas	Técnicas y Métodos de Fitopatología	2-2-3
FI-765	Virus Fitopatógenos	Técnicas y Métodos de Fitopatología Fitopatología Agrícola	2-2-3
SV-766	Fisiología del Parasitismo	Técnicas y Métodos de Laboratorio Bioquímica I	2-2-3
SV-796	Problemas Especiales de Fitopatología	Autorización del Comité	1-3
SV-741	Nemátodes Parásitos de Plantas	Nematología Fisiología Vegetal	2-2-3

5. CURSOS GRADUADOS ELECTIVOS DEL CAMPO COMPLEMENTARIO

Areas recomendables:

Entomología
Estadística
Mejoramiento Genético de Plantas
Biología
Producción Agrícola

Significado de las abreviaturas:

T - Horas de teoría por semana

P - Horas de práctica por semana

C - Número de créditos

SYLLABI DE LOS CURSOS OFRECIDOS EN LA ESPECIALIDAD DE FITOPATOLOGIA

FI-651 MICOLOGIA (2-2)3 cr.
Pre-requisito: Biología I
Introducción al conocimiento de las características morfológicas y fisiológicas más importantes de los hongos poniendo especial énfasis en los grupos más generales que puedan servir de base para estudios especializados.

FI-761 TECNICAS Y METODOS DE FITOPATOLOGIA (3-2) 4cr.
Pre-requisito: Fitopatología General
Estudio de los principios de investigación fitopatológicas incluyendo la aplicación del método científico. Las prácticas incluirán la apreciación de problemas fitopatológicos, revisión de literatura, experimentos y técnicas de laboratorio e invernadero y la evaluación y presentación de datos.

FI-762 HONGOS FITOPATOGENOS (3-2) 4cr.
Pre-requisitos: Micología
Fitopatología Agrícola
Morfología y Taxonomía de los Hongos Fitopatógenos. Técnicas utilizadas para su identificación. Diagnosis de las enfermedades que producen.

FI-763 FITOPATOLOGIA AVANZADA (3-2) 4cr.
Pre-requisito : Fitopatología Agrícola
Un estudio en profundidad de los conceptos básicos de etiología, sintomatología, patogénesis, epifitiología y control de las enfermedades de las plantas.

FI-662 CONTROL DE ENFERMEDADES DE LAS PLANTAS
Pre-requisito : Fitopatología Agrícola
Evaluación de pérdidas, control por exclusión, erradicación, terapia y protección. Clases de fungicidas y bactericidas: su aplicación, características deposicionales, fitoxicidad, regulación, métodos de ensayo y mecanismos de acción.

FI-764 BATERIAS FITOPATOGENAS (2-2) 3cr.
Pre-requisito : Técnicas y Métodos de Fitopatología
Morfología, Biología y Taxonomía de las Bacterias fitopatógenas. Diagnosis de las enfermedades que producen.

FI-765 VIRUS FITOPATOGENOS (2-2) 3cr.
Pre-requisitos: Técnicas y Métodos de Fitopatología
Fitopatología Agrícola
Estudio de los virus de las plantas incluyendo los efectos sobre sus huéspedes. Estudio de transmisión, clasificación, métodos de purificación, determinación de sus propiedades, naturaleza química, estructura y multiplicación. Diagnosis de las enfermedades que producen.

FI-766 FISIOLOGIA DEL PARASITISMO (2-2) 3cr.
Pre-requisitos: Técnicas y Métodos de Fitopatología
Bioquímica I
Estudio de los conceptos fundamentales e información reciente sobre la fisiología del parasitismo.

FI-741 NEMATODES PARASITOS DE PLANTAS (2-2) 3cr.
Pre-requisitos: Nematología
Fisiología Vegetal
Estudio detallado de los nemátodos que atacan a las plantas cultivadas.

Table 23. Agronomy

ESPECIALIDAD DE PRODUCCION AGRICOLA

Es impostergable incrementar la producción y la productividad de los cultivos alimenticios para satisfacer la demanda. La subproducción ha traído consigo un desbalance que ha originado un vertiginoso incremento de la importación de alimentos. Esto plantea al sector agrario y por tanto a los encargados de guiar la preparación técnica y profesional de los futuros líderes de la producción agrícola nacional, la obligación de encarar el problema en su fase de orientación académica primero y su objetivo ulterior de obtener el incremento y optimización de la productividad agrícola por unidad de superficie y tiempo.

Uno de los medios de incrementar la producción unitaria es el buen manejo de los cultivos a través de un adecuado uso de los suelos, los fertilizantes, el agua y los recursos del clima; un segundo modo es el uso de variedades mejoradas, de alta capacidad genética para el rendimiento; un tercer modo es por la evasión/control de plagas, enfermedades y malezas, mediante el adecuado uso de métodos. agronómicos, biológicos y químicos que evitan la merma de los rendimientos por planta.

La Universidad Nacional Agraria ha hecho bastante esfuerzo e impacto a través de su Programa de Graduados y de sus Programas de Investigación Agrícola para desarrollar el segundo medio de incremento de la producción. Prueba de ello es la receptibilidad dada por la agricultura a las semillas y servicios que prestan sus programas de investigación en varios cultivos.

Sin embargo, es necesario reforzar y alertar la preparación académica y formación de grupos de trabajo de investigación en el área particular del manejo y conducción de los cultivos acorde a un nuevo planteamiento que exige la modernización de nuestors métodos de producción agrícola en un ambiente y un período de reajustes sociales y cambios de tenencia de tierras, como consecuencia de la Reforma Agraria. Ello exige que se dedique mas atención y estudio a los sistemas de conducción de los cultivos. Que se use técnicas mas convenientes y eficientes que demanda nuestra realidad fisiográfica, edáfica, climatológica y biológica.
Que se dedique mas tiempo y atención al conocimiento de nuestros recursos de suelos y aguas para la agricultura al nivel de cada valle. Que los estudiantes graduados y docentes de la Especialidad de Producción Agrícola dediquen mayor tiempo al estudio pormenorizado de los recursos utilizables de los principales valles agrícolas del Perú para ser mas eficientes en el desempeño de sus tareas una vez egresados. Que se coordine y encauce el conocimiento e investigación relativa a la zonificación de los cultivos con criterios económicos, técnicos y de bien social. Que se conozca y popularice los estudios e informes técnicos que existen de los diferentes valles agrícolas del país para utilización y aplicación inmediata.

En suma, el reajuste económico y social que vive el país, impone a la Universidad Nacional Agraria la necesidad de adiestrar más profundamente a profesores universitarios, investigadores y agrónomos en general en las técnicas modernas y científicas de la Producción Agrícola.

REQUISITOS DE CURSOS PARA LA OBTENCION DEL GRADO DE MAGISTER SCIENTIAE EN LA ESPECIALIDAD DE PRODUCCION AGRICOLA

1. CURSOS NO GRADUADOS REQUISITOS PARA LA ADMISION

Agrotecnia
Botánica General
Cálculo II
Ecología Agrícola
Fisiología Vegetal
Mecanización Agrícola I ó Maquinaria Agrícola I y II
Principios de Economía I

2. CURSOS NO GRADUADOS OBLIGATORIOS NO REQUISITOS PARA LA ADMISION

Estadística General
Ecofisiología de la Producción Agrícola
Control Químico de Malezas

Dentro de esta categoría se considerarán todos los cursos no graduados que el Comité Consejero considere necesario para completar la preparación de cada estudiante de acuerdo a la orientación escogida.

3. CURSOS AVANZADOS Y GRADUADOS OBLIGATORIOS DEL CAMPO PRINCIPAL

Código	Cursos	Pre-requisitos	T-P-C
ES-611	Estadística Aplicada I	Métodos Estadísticos para la Investigación	3-2-4
FT-773	Fisiología de Cultivos	Ecofisiología de la Producción Agrícola	3-0-3
FT-774	Sistemas y Métodos de Producción Agrícola	Fisiología de Cultivos	3-0-3
FT-793	Seminario de la Producción Agrícola I	Aprobación del Comité Consejero	1
FT-794	Seminario de la Produc. Agrícola II	Aprobación del Comité Consejero	1
FT-798	Investigación en Producción Agrícola	Aprobación del Comité Consejero	1-6

4. CURSOS AVANZADOS Y GRADUADOS ELECTIVOS DEL CAMPO PRINCIPAL

FT-671	Ecología Agrícola Avanzada	Ecología Agrícola, más 150 créditos	3-0-3
EP-716	Administración y Programación Agrícola	Análisis Microeconómico	3-0-3
FT-731	Manejo de Pasturas Avanzado	Manejo de Pasturas	3-0-3
FT-732	Producción y Manejo de Semilla Mejorada.	Manejo y Control de Semillas	2-2-3
SF-751	Fertilidad Avanzada del Suelo I	Fertilidad del Suelo	3-2-4
FT-772	Fisiología de la Acción Herbicida	Control Químico de Malezas	2-2-3

5. CURSOS GRADUADOS ELECTIVOS DEL CAMPO COMPLEMENTARIO

Areas recomendables: Biología.
Economía Agrícola
Estadística
Ingeniería Agrícola
Ingeniería de Recursos de Agua y Tierra
Mejoramiento Genético de Plantas
Entomología
Fitopatología
Suelos

SYLLABI DE LOS CURSOS OFRECIDOS EN LA ESPECIALIDAD DE PRODUCCION AGRICOLA

FS-611 ESTADISTICA APLICADA I (3-2) 4 cr. P.C
Pre-requisito: Métodos Estadísticos para la Investigación
Breve introducción a las probabilidades, principales distribuciones de probabilidad, población y muestra. Pruebas de hipótesis, tablas de contingencia, regresión lineal simple, correlación, análisis de la varianza de diseños con un criterio de clasificación y con criterios múltiples de clasificación.

FT-671 ECOLOGIA AGRICOLA AVANZADO (3-0) 3cr. P.E
Pre-requisito: Ecología Agrícola, más 150 créditos
Información básica sobre el mecanismo operativo de la interrelación de la planta con su ambiente, enfatizando en aquellos factores que el hombre puede modificar para obtener el máximo beneficio de los recursos naturales incidentes en la producción agrícola. Se incluye diagnóstico de la realidad peruana en materia de problemas y disponibilidad de ciencia y tecnología, dentro del ámbito de la Ecología Agrícola.

EP-726 ADMINISTRACION Y PROGRAMACION AGRICOLA (3-0) 3cr. P.E
Pre-requisito: Análisis Microeconómico
La aplicación de los principios económicos en la solución de problemas de producción en fundos típicos; métodos y técnicas de análisis económico de la empresa agrícola, aplicación de la investigación en las decisiones de producción.

FT-731 MANEJO DE PARTURAS AVANZADO (3-0) 3cr. P.E
Pre-requisito: Manejo de Pasturas
Información básica sobre los mecanismos de interdependencia de suelo-planta-animal, en términos de optimización de la productividad pecuaria. Se enfatiza el uso racional de la vegetación como un parámetro condicionante para la máxima producción por unidad de superficie, unidad animal y unidad de tiempo, manteniendo la potencialidad de los recursos naturales. Se incluye diagnóstico de la realidad peruana y se plantean esquemas teórico-prácticos de manejo forrajero.

FT-732 PRODUCCION Y MANEJO DE SEMILLA MEJORADA (2-2) 3cr. P.E
Pre-requisitos: Ser alumno graduado
Manejo y Control de Semillas
Estudio analítico de las características anatómicas y fisiológicas de las semillas. Características específicas de producción de semilla de los cultivos agrícolas de mayor importancia en el país.
Certificación de Semilla: sus reglamentos y leyes. Comercialización y procesamiento de las semillas.

SF-751 FERTILIDAD AVANZADA DEL SUELO I (3-2) 4cr. P.E.
Pre-requisito: Fertilidad del Suelo
Estudio del sistema suelo y de la utilización de nutrientes por las plantas. Interrelación entre las propiedades del suelo, la disponibilidad de nutrientes y el comportamiento de los fertilizantes.

FT-772 FISIOLOGIA DE LA ACCION HERBICIDA (2-2) 3cr. P.E.
Pre-requisito: Control Químico de Malezas
Analiza los procesos de absorción, traslocación y degradación de herbicidas por las plantas. Discute el modo, mecanismo y sitio de los herbicidas en las plantas. Estudia el comportamiento de herbicidas en el suelo. Analiza las bases de la selectividad de los herbicidas.

FT-773 FISIOLOGIA DE CULTIVOS (3-0) 3cr. P.O
Pre-requisito: Ecofisiología de la Producción Agrícola
Destaca el rol de la fisiología vegetal en la obtención de máximos rendimientos de los cultivos. Identifica y describe en los principales cultivos agronómicos, los procesos fisiológicos más importantes para su crecimiento, desarrollo y producción. Analiza los factores que influyen en los procesos fisiológicos destacando aquellos susceptibles de ser manipulados para mejorar la producción agrícola.

FT-774 SISTEMAS Y METODOS DE PRODUCCION AGRICOLA (3-0) 3cr. P.O
Pre-requisito: Fisiología de Cultivos
Analiza la adecuada utilización de los recursos e insumos que conducen a un eficiente y económico rendimiento unitario. Identifica las bases científicas para desarrollo técnico de producción agrícola, diseña y evalua los métodos y sistema de producción, identificando también los factores mas críticos y posibles de mejorar.

FT-793 SEMINARIO DE PRODUCCION AGRICOLA I 1 cr. P.O
Pre-requisito: Aprobación del Comité Consejero
Presentación y desarrollo de un tema de la Especialidad fijada por el Coordinador

FT-794 SEMINARIO DE PRODUCCION AGRICOLA II 2 cr. P.O
Pre-requisito: Aprobación del Comité Consejero
Presentación y desarrollo de un tema más avanzado de la especialidad y fijada por el Coordinador de Seminarios.

FT-795 INVESTIGACION EN PRODUCCION AGRICOLA 1 á 6 créditos
Pre-requisito: Aprobación del Comité Consejero
Estudios originales que conducen a la elaboración de un Proyecto de Tesis, cuya discusión previa conduce a la ejecución final y representa el tema de tesis en la especialidad.

Table 34. Plant Breeding

PROGRAMA ACADEMICO DE GRADUADOS
UNIVERSIDAD NACIONAL AGRARIA

ESPECIALIDAD DE MEJORAMIENTO GENETICO DE PLANTAS

La Especialidad de Mejoramiento Genético de Plantas, tiene por objeto capacitar investigadores que puedan ser utilizados en los diferentes campos del mejoramiento genético de las plantas cultivadas. Para cumplir esta función, el alumno recibirá una instrucción teórica en los diferentes campos de la investigación genética, estadística y mejoramiento, de acuerdo a programas establecidos por el Comité Consejero para cada alumno individualmente.

El alumno que sigue estudios graduados en esta Especialidad, tendrá la oportunidad de realizar su investigación y entrenamiento en los Programas de Mejoramiento Genético con que cuenta el Departamento, tales como: Frutales, Hortalizas, Maíz, Papa y Trigo.

El Departamento de Fitotecnia ofrece a los estudiantes graduados de la Especialidad el grado académico de Magister Scientiae, en un período de dos años y cuenta con un excelente plantel de docentes con grados académicos avanzados conduciendo proyectos de investigación.

Los candidatos a la Especialidad deberán ostentar el título de Ingeniero Agrónomo o el grado de Bachiller de una Universidad reconocida por la Universidad Nacional Agraria y cumplir con los requisitos que exige el Programa Académico de Graduados.

REQUISITOS DE CURSOS PARA LA OBTENCION DEL GRADO DE MAGISTER SCIENTIAE EN LA ESPECIALIDAD DE MEJORAMIENTO GENETICO DE PLANTAS

1. CURSOS NO GRADUADOS REQUISITOS PARA LA ADMISION

Cálculo Diferencial e Integral
Estadística General
Botánica Sistemática
Fitomejoramiento General
Fisiología Vegetal
Genética General

2. CURSOS NO GRADUADOS OBLIGATORIOS NO REQUISITOS PARA LA ADMISION

Dentro de esta categoría se considerarán todos los cursos no graduados que el Comité Consejero considere necesarios para completar la preparación de cada estudiante de acuerdo con la orientación escogida.

3. CURSOS GRADUADOS OBLIGATORIOS DEL CAMPO PRINCIPAL

Código	Cursos	Pre-requisitos	T-P-C
ES-611	Estadística Aplicada I	Métodos Estadísticos p. Investigación I	3-2-4
FT-711	Genética Vegetal Avanzada	Genética General	3-0-3
FT-712	Mejoramiento de Plantas I	Estadística General Genética General Fitomejoramiento General	3-0-3
FT-791	Seminario de Mejoramiento Genético de Plantas I	Autorización del Comité	1
FT-792	Seminario de Mejoramiento Genético de Plantas II	Autorización del Comité	1
FT-799	Investigación en Mejoramiento Genético de Plantas	Autorización del Comité	1-6

4. CURSOS GRADUADOS ELECTIVOS DEL CAMPO PRINCIPAL

BI-631	Citogenética	Genética General	3-2-4
BI-613	Fisiología Vegetal Avanzada	Fisiología Vegetal	3-2-4
FT-713	Mejoramiento de Plantas Tuberíferas Andinas	Fitomejoramiento General	2-0-2

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Especialidad de Mejoramiento Genético de Plantas

Código	Cursos	Pre-requisitos	T-P-C
HO-631	Mejoramiento de Hortalizas	Ser alumno graduado	2-2-3
FT-714	Mejoramiento de Plantas II	Mejoramiento de Plantas I	3-2-4
FT-715	Colloquium de Mejoramiento de Plantas	Ser alumno graduado	2-0-2
FT-716	Mejoramiento Cuantitativo y de Poblaciones	Estadística Aplicada I	3-0-3
FT-717	Análisis de Experimentos Genéticos	Mejoramiento Cuantitativo y de Poblaciones	2-0-2
FT-718	Diseños Experimentales	Estadística Aplicada I	3-2-4
FT-719	Mejoramiento de Cereales (Maíz y Trigo)	Mejoramiento de Plantas I	2-2-3
FT-795	Problemas Especiales de Mejoramiento Genético de Plantas	Ser alumno graduado	1-3

5. CURSOS GRADUADOS ELECTIVOS DEL CAMPO COMPLEMENTARIO

Areas recomendables:

Biología
Suelos
Fitopatología
Estadística
Química
Producción Animal

Significado de las abreviaturas :

T - Horas de teoría por semana
P - Horas de práctica por semana
C - Número de créditos

SYLLABI DE LOS CURSOS OFRECIDOS EN LA ESPECIALIDAD DE MEJORAMIENTO GENETICO DE PLANTAS

ES-611 ESTADISTICA APLICADA I (3-2) 4cr.
Pre-requisito: Métodos Estadísticos para la Investigación I
Breve introducción a la probabilidades, principales distribuciones de probabilidad, población y muestra, pruebas de hipótesis, tablas de contingencia, regresión lineal simple, correlación análisis de la variancia de diseños con un criterio de clasificación y con criterios múltiples de clasificación.

FT-711 GENETICA VEGETAL AVANZADA (3-0) 3cr.
Pre-requisito: Genética General
Principios básicos de la herencia y la acción de los genes en la expresión de los atributos. Revisión de los conceptos fundamentales de la genética a la luz de los hallazgos de la bioquímica, fisiología y la biología molecular, orientando su aplicación en la investigación y el mejoramiento genético y cuantitativo y de poblaciones de plantas cultivadas.

FT-712 MEJORAMIENTO DE PLANTAS I (3-0) 3cr.
Pre-requisitos: Estadística General
Genética General
Fitomejoramiento General
Bases teóricas que soportan y explican los mecanismos hereditarios que se llevan a cabo durante el proceso de selección. Fundamento teórico de los principales métodos de mejoramiento de los cultivos y su interacción con el ambiente.

BI-613 FISIOLOGIA VEGETAL AVANZADA (3-2) 4cr.
Pre-requisito: Fisiología Vegetal
Organización estructura y función en el reino vegetal: niveles de integración, fisiología del crecimiento y desarrollo. El ambiente y las plantas: fenología. Nutrición de las plantas. Reguladores químicos del crecimiento. El agua y las plantas. Biconversión de energía.

FT-713 MEJORAMIENTO DE PLANTAS TUBERIFERAS ANDINAS (2-0) 2cr.
Pre-requisito: Fitomejoramiento General
Mejoramiento de plantas tuberíferas: papa (solanum tuberosum sens, lat) oca (Oxalis tuberosum mol), ulluco (Ullucus tuberosum loz), masnua o isaño.

FT-714 MEJORAMIENTO DE PLANTAS II (3-2) 4cr.
Pre-requisito: Mejoramiento de Plantas I
Métodos de selección y mejoramiento de algunos cultivos de importancia económica de la costa, sierra y trópico.

FT-715 COLLOQUIUM DE MEJORAMIENTO DE PLANTAS (2-0) 2cr.
Pre-requisito: Ser alumno graduado

FT-716 MEJORAMIENTO CUANTITATIVO Y DE POBLACIONES (3-3) 3cr.
Pre-requisito: Estadística Aplicada I
Conceptos biomatemáticos de la herencia, frecuencia de genes, sistemas de apareamiento, relaciones de parentesco y sistemas de endocría. Cambios de frecuencia de genes por la selección de mutuación, migración, aislamiento etc. Variación continua y estimación de parámetros genéticos, aplicaciones. Grado de aproximación de los estimados teóricos.

Syllabi de la Especialidad de Mejoramiento Genético de Plantas

FT-717 ANALISIS DE EXPERIMENTOS GENETICOS (2-2) 2cr.
Pre-requisito : Mejoramiento Cuantitativo y de Poblaciones
Métodos de estimación de parámetros genéticos por el método de regresión y los análisis de varianza por medio de los diseños jerárquicos y de clasificación múltiple. Construcción de los Indices de Selección. Uso de los coeficientes de Path para las relaciones genéticas.

FT-718 DISEÑO EXPERIMENTALES (3-2) 4cr.
Pre-requisito: Estadística Aplicada I
Análisis de varianza de los principales diseños experimentales usados en Mejoramiento de Plantas y ensayos agronómicos. Principios de randomización. Factoriales. Confundido. Transformación de datos.

FT-719 MEJORAMIENTO DE CEREALES (MAIZ Y TRIGO) (2-2) 3cr.
Pre-requisito: Mejoramiento de Plantas I
Métodos y técnicas en el mejoramiento de los cereales de mayor importancia económica: Maíz, trigo, cebada etc.

Table 35. Agricultural Economics

PROGRAMA ACADEMICO DE GRADUADOS
UNIVERSIDAD NACIONAL AGRARIA

ESPECIALIDAD DE ECONOMIA AGRICOLA

El Programa Académico de Graduados ofrece un programa de estudios que conducen a la obtención del grado de Magister Scientiae en la Especialidad de Economía Agrícola. La conveniencia de estos estudios surge de la necesidad que tienen los países en materia de análisis y planes económicos del sector agrícola, que comprendan investigaciones sobre producción distribución y consumo, reforma agraria, localización y evaluación de proyectos, etc. Por estas razones es necesario la preparación de profesionales científicamente capacitados en el análisis y planificación eficaz del sector correspondiente. Esta capacitación puede lograrse a través de estudios graduados en Economía Agrícola, los cuales brindan a los interesados una adecuada preparación teórica y práctica en esta Especialidad.

La Especialidad de Economía Agrícola está encaminada a la formación de profesionales con una sólida preparación científica que les permita desempeñarse en las diversas áreas de esta ciencia La admisión para seguir estudios graduados en Economía Agrícola está abierta a todos los profesionales que reunan los requisitos de la Especialidad, existiendo especial demanda por parte de Ingenieros Agrónomos y Economistas con interés en los problemas económicos del agro y que desarrollarán sus actividades profesionales tanto en el sector privado como en el sector público.

La conducción de los estudios está encomendada a un selecto personal con estudios avanzados e Instituciones de prestigio internacional, los cuales se encuentran conduciendo múltiples proyectos de investigación de alcance nacional.

REQUISITOS DE CURSOS PARA LA OBTENCION DEL GRADO DE MAGISTER SCIENTIAE EN LA ESPECIALIDAD DE ECONOMIA AGRICOLA

1. CURSOS NO GRADUADOS REQUISITOS PARA LA ADMISION (o sus equivalentes)

Algebra I
Cálculo I (Diferencial e Integral)
Estadística General
Cálculo II (Diferencial e Integral)
Análisis Macroeconómico
Análisis Microeconómico

2. CURSOS NO GRADUADOS OBLIGATORIOS NO REQUISITOS PARA LA ADMISION

Algebra III
Agrotecnia General
Zootecnia General

3. CURSOS GRADUADOS OBLIGATORIOS DEL CAMPO PRINCIPAL

Código	Cursos	Pre-requisitos	T-P-C
EP-715	Análisis Cuantitativo para Economistas	-	3-0-3
EP-712	Teoría Macroeconómica Avanzada	Análisis Macroeconómico	3-0-3
EP-711	Teoría Microeconómica Avanzada	Análisis Microeconómico	4-0-4
EP-791	Seminario de Economía Agrícola I	-	1
EP-792	Seminario de Economía Agrícola II	-	1
EP-799	Investigación en Economía Agrícola	-	1-6

4. CURSOS GRADUADOS ELECTIVOS DEL CAMPO PRINCIPAL

Código			
EP-716	Administración y Programación Agrícola	Análisis Microeconómico	3-0-3
EP-731	Comercio Interregional e Internacional	Análisis Microeconómico Análisis Macroeconómico	3-0-3
EP-716	Finanzas Públicas	Análisis Macroeconómico	3-0-3
EP-651	Formulación y Evaluación de Proyectos	Desarrollo Económico	3-0-3

Especialidad de Economía Agrícola

Código			T-P-C
EP-631	Introducción a la Econometría	Análisis Microeconómico Análisis Macroeconómico Métodos Estadísticos para las Ciencias Sociales	3-0-3
EP-732	Mercadotecnia Agrícola Avanzada	Análisis Microeconómico Análisis Macroeconómico	3-0-3
EP-751	Política y Planes Agrícolas	Análisis Microeconómico	3-0-3
EP-671	Programación Lineal en Economía	Algebra III Análisis Microeconómico	3-0-3
EP-714	Teoría del Desarrollo y Crecimiento Económico.	Análisis Macroeconómico Análisis Microeconómico	3-0-3

5. CURSOS GRADUADOS ELECTIVOS DEL CAMPO COMPLEMENTARIO

Areas recomendables:

Estadística

Producción Agrícola

Producción Animal

Significado de las abreviaturas:

T - Horas de teoría por semana

P - Horas de práctica por semana

C - Número de créditos

SYLLABI DE LOS CURSOS OFRECIDOS POR LA ESPECIALIDAD DE ECONOMIA AGRICOLA

EP-715 ANALISIS CUANTITATIVO PARA ECONOMISTAS (3-0) 3 cr.
Pre-requisito: Ninguno
El propósito de este curso es el de exponer sistemáticamente ciertos métodos matemáticos y relacionar estas técnicas a varios tipos de análisis económicos. El curso revisa modelos económicos lineales y no lineales, usando Algebra Lineal, Cálculo Diferencial e Integral y Funciones Matemática que estén más relacionados con la Economía (funciones exponenciales y logarítmicas). Los tópicos en que se dan más énfasis son: Análisis Estadístico, Análisis de Estadística Comparativa y Problemas de Optimización

EP-712 TEORIA MACROECONOMICA AVANZADA (3-3) 3 cr.
Pre-requisito: Análisis Macroeconómico
Estructura teórica y real del crecimiento, empleo y desempleo. Inflación, Fluctuaciones y ciclos Estabilidad de los sistemas.

EP-711 TEORIA MICROECONOMICA AVANZADA (4-0) 4cr.
Pre-requisito: Análisis Microeconómico
Teorías tradicionales de la firma y mercados de competencia, y modelos contemporáneos.

EP-716 ADMINISTRACION Y PROGRAMACION AGRICOLA (3-0) 3cr.
Pre-requisito: Análisis Microeconómico
La aplicación de los principios económicos en la solución de problemas de producción en fondos típicos métodos y técnicas de análisis económicos de la empresa agrícola, aplicación de la investigación en las decisiones de producción.

EP-731 COMERCIO INTERREGIONAL E INTERNACIONAL (3-0) 3cr.
Pre-requisitos: Análisis Microeconómico
Análisis Macroeconómico

Crítica de los últimos aportes a la teoría del comercio internacional, introducción de la teoría de las economías dominantes y análisis preferente de los ejemplos y experiencia contemporáneas en materia de comercion interregional.

EP-713 FINANZAS PUBLICAS (3-0) 3cr.
Pre-requisitos: Análisis Macroeconómico
Efecto de los impuestos sobre la distribución de los ingresos. Métodos de movilización del capital financiero para el crecimiento e influencia de las políticas fiscales sobre el desarrollo. Análisis comparativo de los sitemas impositivos de varios países insuficientemente desarrollados.

EP-651 FORMULACION Y EVALUACION DE PROYECTOS (3-0) 3cr.
Pre-requisitos: Análisis Microeconómico
Examen de las ventajas y desventajas económicas de los alcances a corto y largo plazo y limitaciones metodológicas que supone la elección de proyectos específicos dentro de la planificación.

Syllabi de la Especialidad de Economía Agrícola

EP-631 INTRODUCCION A LA ECONOMETRIA (3-0) 3cr.
Pre-requisitos: Análisis Microeconómico
Estadística I
Los principios de la construcción econométrica, la elaboración y empleo de modelos y el examen de resultados de la investigación que liga los métodos estadísticos a la determinación de las leyes cuantitativas concretas que rigen la vida económica.

EP-732 MERCADOTECNIA AGRICOLA AVANZADA (3-0) 3cr.
Pre-requisitos: Análisis Microeconómico
Análisis del sistema de mercados agrícolas y de las fuerzas que determinan y afectan su estructura y eficiencia; las firmas productores de servicios y su rol en la formación de precios; influencia de las políticas gubernamentales al respecto; métodos para la eficiencia del mercado de productos.

EP-751 POLITICA Y PLANES AGRICOLAS (3-0) 3cr.
Pre-requisitos: Análisis Microeconómico
Análisis Macroeconómico
Estudio de los criterios que gobiernan las decisiones elaboradas en función de objetivos comparativos con las necesidades y recursos y con las medidas posibles de utilizarse, así como de las técnicas de repartición de los objetivos del sector agrícola en objetivos por producto y por zona o región.

EP-671 PROGRAMACION LINEAL EN ECONOMIA (3-3) 3cr.
Pre-requisitos: Análisis Microeconómico
Algebra III
Estudio de la programación económica cuyas variables poseen relaciones lineales y forman sistemas de ecuaciones e inecuaciones, según sus aspectos particular y general, con aplicación en diversos casos de producción, distribución y consumo a niveles micro y macro.

EP-714 TEORIA DEL DESARROLLO Y CRECIMIENTO ECONOMICO (3-0) 3cr.
Pre-requisitos: Análisis Microeconómico
Análisis Macroeconomico
Análisis del desarrollo y del sub-desarrollo, Metodología estructuralista frente a diversos modelos de crecimiento económico.

Table 36. Professors Responsible For The Advanced Courses.

RELACION DE DOCENTES CON GRADOS AVANZADOS

AGUILAR FERNANDEZ, PEDRO GONZALO. Profesor Principal del Dpto. de Biología. Biólogo, Universidad Nacional Mayor de San Marcos, 1972. Dr. Ciencias Biológicas, Universidad Nacional Mayor de San Marcos, 1954.

ALCAZAR GAMARRA DE APARICIO, MARCIA. Profesor Asociado del Dpto. de Ciencias Humanas. Profesor de Educación Segundaria y Filosofía, Pontificia Universidad Católica del Perú, 1967. Bachiller en Educación, Pontificia Universidad Católica del Perú. Doctorado en Educación, P.U.C.P., 1974.

ALIAGA OSORIO, TEOFILO JORGE. Profesor Principal del Dpto. de Tecnología de Alimentos y Productos Agropecuarios. Ingeniero Agrícola, Universidad Agraria, 1966. M.S. University of California-Davis, 1969.

ALMEYDA MATIAS, GUILLERMO FELIX. Profesor Asociado del Dpto. de Física y Meteorología. Dr.Sc., Colorado State University, 1970. M.S. Colorado State University, 1972.

AMES RUIZ DE ICOCHEA, TERESA. Profesor Principal del Dpto. de Fitopatología. Ingeniero Agrónomo, Escuela Nacional de Agricultura, 1957. Ph.D. North Carolina State University, 1966.

ARAUJO RODRIGUEZ, HECTOR. Profesor Asociado del Dpto. de Mecanización Agrícola. Ingeniero Agrícola, Universidad Nacional Agraria, 1976. Mg.Sc. en Ingeniería Agrícola, Universidad Nacional Agraria, 1979.

ARCA BIELICK, MANUEL. Profesor Principal del Dpto. de Suelos y Fertilizantes. Ingeniero Agrónomo, Escuela Nacional de Agricultura, 1951. M.S. University of California-Riverside, 1958. Ph.D. University of California-Riverside, 1966.

ARNAO MENDOZA DE MC. GREGOR, MARGARITA. Profesor Principal del Dpto. de Biología. Bióloga, Universidad Nacional Mayor de San Marcos, 1964. Doctor en Ciencias Biológicas, Universidad Nacional Mayor de San Marcos, 1965.

AROSTEGUI VARGAS, ANTONIO. Profesor Principal del Dpto. de Industrias Forestales. Ingeniero Agrónomo, Escuela Nacional de Agricultura, 1958. M.Agr., IICA, Turrialba, Costa Rica, 1961.

ASTE OBANDO, ANGEL ARNALDO. Profesor Principal del Dpto. de Economía y Planificación. Ingeniero Agrónomo, Universidad Agraria, 1961. M.S. Purdue University, 1963.

BAKULA BUDGE, JUAN MIGUEL. Profesor Principal del Dpto. de Horticultura. Ingeniero Agrónomo, Universidad Agraria, 1966. M.S. University of California-Riverside, 1969.

BASURTO LAVANDA, RAUL ABEL. Profesor Auxiliar del Dpto. de Fitotecnia. Ingeniero Agrónomo, Universidad Nacional Agraria, 1973. Mg.Sc. Universidad Nacional Agraria, 1980.

BAZAN TAPIA, LUIS RUBEN. Profesor Principal del Dpto. de Suelos. Ingeniero Agrónomo, Universidad Nacional Agraria, 1971. M.S. University of Ghent, Bélgica, 1973.

BENDEZU PEREZ-ALBELA, MARIO SAUL. Profesor Principal del Dpto. de Sanidad Animal, Médico Veterinario, Universidad Nacional Mayor de San Marcos, 1969. M.S. de Universidad de Minas Gerais, Brasil, 1973.

BENITES JUMP, JOSE. Profesor Asociado del Dpto. de Fitotecnia. Ingeniero Agrónomo, Universidad Nacional Agraria, 1973. Mg.Sc. Universidad Nacional Agraria, 1975. Ph.D. North Carolina State University, 1981.

BENOIT LARCO DE VELAZCO, BEATRIZ. Profesor Principal del Dpto. de Ciencias Humanas. Ph.D. Universidad de Roma, 1972.

BERMUDEZ RODRIGUEZ, JORGE EMILIO. Profesor Principal del Dpto. de Fitotecnia. Ingeniero Agrónomo, Universidad Nacional Agraria, 1969. Mg.Sc. Universidad Nacional Agraria, 1975.

BRICEÑO DE ASCUÑA, ICELA. Profesor Principal del Dpto. de Química. Químico-Farmaceutica, Universidad Nacional Mayor de San Marcos, 1962. Dra. Farmacia y Bioquímica, Universidad Nacional Mayor de San Marcos, 1973.

CAMARENA MAYTA, FELIX. Profesor Asociado del Dpto. de Fitotecnia, Ingeniero Agrónomo, Universidad Nacional del Centro, 1976. Mg.Sc. Universidad Nacional Agraria, 1973.

CANTO SAENZ, MANUEL ANTONIO. Profesor Asociado del Dpto. de Fitopatología. Ingeniero Agrónomo, Universidad Nacional del Centro, 1963. Mg.Sc. Universidad Nacional Agraria, 1975.

CARPIO PINO, MANUEL ALEJANDRO. Profesor Principal del Dpto. de Producción Animal. Ingeniero Agrónomo, Universidad Agraria, 1962. M.S. New Mexico State University, 1966

CARRASCO GONZALEZ, ARTURO EDUARDO. Profesor Principal del Dpto. de Nutrición. Ingeniero Agrónomo, Escuela Nacional de Agricultura, 1956. Mg.Sc. Universidad de Minas Gerais, Brasil, 1963

CASSANO CUADROS, MARIA DEL CARMEN. Profesor Principal del Dpto. de Física y Meteorología. Ingeniero Químico, Universidad Nacional Mayor de San Marcos, 1946. M.S. North Carlina State University-Raleigh, 1967.

CASTILLO LOAYZA, JAIME AUGUSTO. Profesor Asociado del Dpto. de Fitopatología. Ingeniero Agrónomo, Universidad Nacional Agraria, 1973. M.S. University of California, 1967.

CERRATE VALENZUELA, ALFONSO. Profesor Principal del Dpto. de Fitotecnia. Ingeniero Agrónomo, Escuela Nacional de Agricultura, 1952. M.S. Iowa State University, 1955. Ph.D. University of Nebraska, 1967

CISNEROS VERA, FAUSTO. Profesor Principal del Dpto. de Entomología. Ingeniero Agrónomo, Escuela Nacional de Agricultura, 1959. M.S. North Carolina State University, 1965. Ph.D. University of California-Davis, 1971.

CORNEJO GARRIDO, ANGEL GUSTAVO. Profesor Principal del Dpto. de Física y Meteorología. Licenciado en Física, Universidad Nacional de Ingeniería, 1978. M.S. en Meteorología, University of Massachusetts, 1976.

CUEVA MARTIN, PEDRO JOSE. Profesor Principal del Dpto. de Química. Químico-Farmaceutico, Universidad Nacional Mayor de San Marcos, 1965. Dr. Farmacia y Bioquímica, Universidad Nacional Mayor de San Marcos, 1973.

CHANG -NAVARRO LEVANO, LORENZO. Profesor Principal del Dpto. de Recursos de Agua y Tierra. Ingeniero Agrónomo, Universidad Agraria, 1961. M.S. University of California-Davis, 1967.

CHAUCA FRANCIA, FLOR DE MARIA. Docente Contratado del Dpto. de Ciencias Humanas. Q.F. Universidad Nacional Mayor de San Marcos, 1963. M. in Arts. Cornell University, 1968.

CHAVEZ COSSIO, JUAN. Profesor Auxiliar del Dpto. de Producción Animal. Ingeniero Zootecnista, Universidad Nacional Agraria, 1975. Mg.Sc. Universidad Nacional Agraria, 1979.

CHIRINOS ALMANZA, JOSE ALFONSO. Profesor Principal del Dpto. de Ciencias Humanas. Ingeniero Agrónomo, Universidad Agraria, 1961. M.S. Sociólogo Rural. Cornell University, 1966.

DALE LARRABURE, WILLIAM. Profesor Principal del Dpto. de Entomología. Ingeniero Agrónomo, Universidad Nacional Agraria, 1970. Mg.Sc. Universidad Nacional Agraria, 1971. Ph.D. North Carolina State University, 1974.

DALE SALINAS, CARROL DOUGLAS. Profesor Asociado del Dpto. de Ciencias Humanas, Profesor de Educación Secundaria, Escuela Normal Superior Santo Toribio de Mogrovejo, Lima, 1967. Dr. en Ser. Ciclo Sociología, Universite Rene Descartes, Francia, 1975.

DANCE CABALLERO, JOSE JAVIER. Profesor Asociado del Dpto. de Manejo Forestal. Ingeniero Forestal, Universidad Nacional Agraria, 1974. Mg.Agr. y Forestales, Universidad de Helsinki-Finlandia.

DAVELOUIS MC EVOY, JOSE RAUL. Profesor Principal del Dpto. de Suelos y Fertilizantes. Ingeniero Agrónomo, Universidad Agraria, 1961. Mg.Sc. Universidad Nacional Agraria, 1973.

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ANNEX F

A VERTEBRATE PEST MANAGEMENT PROJECT FOR PERUVIAN AGRICULTURE

ANNEX F

A VERTEBRATE PEST MANAGEMENT PROJECT FOR PERUVIAN AGRICULTURE

SUMMARY OF PROBLEM

Vertebrate pests are among the factors contributing to a widespread and acute disparity between population and available food in many developing countries. Historically, vertebrates have not received the degree of attention given to other agricultural pests. Vertebrate damage in agriculture involves a variety of crops and animal species (primarily rodents and birds), and it has become increasingly evident that they play a major role in limiting production. Direct losses to vertebrates occur throughout crop development and under postharvest storage conditions. Losses may alter the food value, as when rats selectively remove the germ from stored corn, or may result from contamination of food with urine, feces, feathers, or hair. Indirect losses may result from animals burrowing into earthen dams and levees. Some rodent species may significantly reduce reforestation potential, disturb rangelands, or severly damage orchards. Birds, sometimes numbering in the millions, can decimate grainfields. Associated diseases, which are infectious to man or domestic animals, are also an important factor.

Contacts with agricultural personnel, reviews of available literature, and first hand observations indicate that vetebrate depredations of agricultural crops occur throughout Latin America and are, in some instances, a limiting factor in agricultural production. Except in a few isolated cases, little organized and reliable information is available on the species and crops involved, the degree of damage, and the resultant impact on the agricultural economy. Meager attempts have been made to define the problems, or evaluate the suitability of control agents or methodologies, primarily because the people responsible for crop protection in Latin American countries have little training or experience in vertebrate pest control.

ECONOMICS

In the absence of other data, information on crop losses in other Latin American countries compiled by the Denver Wildlife Research Center (DWRC) are presented to illustrate the potential severity of vertebrate problems. Rodent damange to corn in one area of Honduras during 1976 was estimated at 24-28%; rodent damage to rice in Nicaragua was estimated at 26% in 1971; observations of dove damage to sorghum plantations in Uruguay ranged from 30% to 40% in 1977; reports from the INVIERNO program in Nicaragua indicated losses of 34% in corn and 21% in beans, on small farms in the Matiguas area. An FAO plant protection bulletin states, "Disasterous crop losses are reported repeatedly from Northeast Brazil. Argentina's crops are subject to severe attack by rodents. Rangeland destruction by rodents is an important problem in Chile." An April 1977 report of the Agricultural Attache in Guatemala stated that a BID loan for planting African oil palm in the Aguan Valley of Honduras was only 16% utilized, partially as a result of a rodent infestation that

destroyed almost 500 has. of new plantings within a 2-month period." In Peru, the Sub-Direccion de Sanidad Vegetal, Ministerio de Alimentacion, estimated crop losses to bird and rodents in 1976 at approximately US$4 million.

Food production is affected by a myriad of interlocking factors and forces. Vertebrate pests constitute a small but significant piece of the puzzle. Certainly the reduction or prevention of losses to these pests would represent an important contribution to the solution of hunger problems in the developing countries of Latin America. However, progress in improving vertebrate control programs in these countries will be largely dependent on the development of trained personnel and the acquisition of a capability to define the problems and to develop, adapt, and evaluate methodology.

PROPOSED RESPONSE

This proposal is intended to address the problems described above through a program of applied research and development of appropriate technologies along with a training and extension program designed to enhance host government capabilities in the specialized field of vertebrate pest control research and management. A significant initial step toward this end was taken with the establishment of a Regional Vertebrate Pest Control Project for the Caribbean (Project Number 598-0584). The project proposed here is viewed as a logical and desirable addition of this initial effort, designed to serve the needs of a second major geographical region of Latin America, specifically Peru. The project is proposed as a 5-year contract with the Denver Wildlife Research Center, the first year to serve as the planning year for project development.

GOAL, PURPOSE, OUTPUTS, INPUTS

GOAL:

To improve the standard of living in agricultural areas of participating countries by increasing crop productivity and farm income.

PURPOSE:

To develop appropriate vertebrate pest control tech-nologies which may be used by the Government of Peru to reduce both pre-and postharvest agricultural losses to rodents and other vertebrate pests on traditional farms.

OUTPUTS:

Outputs expected at the end of the project include: 1) a functional field unit to address vertebrate pest control problems and an institutional capacity to effectively adapt and implement appropriate vertebrate pest management technologies to indigenous conditions; 2) trained personnel actively con-ducting vertebrate pest research and/or extension programs utilizing recommended packages of improved technology; 3) work shops/seminars/on-the-job training programs involving special ists and farmers in the testing of appropriate control programs; 4) active vertebrate pest programs which

incorporate funds within operating budgets for financing selected activities; and 5) dissemi-nation of information and results within Peru and to other interested countries in the Latin American region.

INPUTS:

Project inputs are discussed in greater detail in Summary of Estimated Costs. Basically, the following resources are required to achieve project goals: 1) one long-term resident biologist with technical expertise in vertebrate pest management methods; 2) approximatedly 14 person-months of short-term consultation from DWRC to support pro-gram activities of the field unit; 3) supporting services (including facilties and staff) at DWRC for specialized laboratory studies, analyses, or development; 4) physical facilities, including offices and laboratories at the field unit site; 5) personnel provided by participating countries including biologists, administrative support, and secretarial services; 6) equipment, supplies and transportation to conduct laboratory and field studies; 7) operating funds for local travel and procurement and in-country materials and supplies; 8) training (both long-term formal and short-term informal) for counterpart personnel assigned to the project.

CRITICAL ASSUMPTIONS PERTINENT TO PROJECT SUCCESS

On the basis of past experience and knowledge of the elements necessary for the success of a project of this nature, the following assumptions are made: 1) that a field unit established in one location will be able to service select regions; 2) that the USAID Mission (or other donor agency) recognize vertebrate pest control to be a serious problem and will assign it the priority necessary to make a long-range project worthwhile; 3) that governments, agencies and institutions concerned will recognize vertebrate pest control as one of their serious agricultural problems and agree to become participating parties; 4) that the Government of Peru will designate personnel for specialized vertebrate control training and subsequently retain them in that area of specialization; and 5) that the Government of Peru support the vertebrate control research and extension activities and make use of the control technology packages developed as a result of the project.

RELATED ACTIVITIES

Only one vertebrate pest control program, as such, exists in Latin America. This is the Instituto Colombiano Agropecuario (ICA) vertebrate pest control program at Palmira, Colombia, which was initiated as a result of an earlier AID/DWRC project (1970-74). The only other similar programs which may exist are concerned solely with vampire bat control. These also came about as a direct result of the AID/DWRC vampire bat control research and utilization project. On the basis of these earlier successful efforts in the Latin American area and the present lack of similar programs, this project can contribute significantly to achievement of increases in small farm produce and therefore merits consideration as an AID (or other donor) funded program.

With funds provided by a Participating Agency Service Agreement (PASA) between AID's Technical Assistance Bureau and the Denver Wildlife Research Center, a program was initiated in rodent control in the Philippines in 1967.

That program has since developed considerable rodent control tehnology which, with minor adaptation to specific local conditions and species, should be applicable in Peru.

In the past 5 years, several countries have entered into bilateral or regional arrangements with DWRC to establish vertebrate control programs. Bangladesh, the Dominican Republic, Sudan, and Haiti are examples of countries embarking on systematic rodent and bird control projects utilizing DWRC research and technical services. Training is an important component of these undertakings. By utilizing the results of earlier research efforts, and in turn perfecting control strategies through applied and adaptive research and field evaluation, participating host country institutions are more effective in addressing their specific concerns. This project represents a needed and logical initiative in the South American region.

ALTERNATIVES TO THE PROJECT

Historical evidence suggests that neither government institutions nor AID target groups are fully aware of the extent of vertebrate pest damage in Peru. As a result, control operations have been largely confined to sporadic poisoning campaigns when pest populations reach plague proportions. This general lack of understanding of the extent of crop losses in the field and during postharvest storage is likely to continue unless adequate damage survey data are available for government institutions to assess the priority need for work in this area. Until this is achieved, it is probable that governement organizations will do nothing more than continue these sporadic efforts in response to farmer complaints. Without a systematic approach to define problems in terms of crop losses and use of research findings to develop effective management programs, vertebrate pest losses are likely to continue unabated and will probably become more intense as agricultural development proceeds.

An alternative to the project design, as proposed, would be direct transfer of control approaches developed elswhere, and concentration on training of extension officers and farmers directly in these methods. This has the advantage of putting major resources into activities which might benefit the farmer more directly and reduce the time span to implementation. However, the disadvantages are judged to outweigh the advantages. There are relatively few existing methods that have been designed for use on small farms in Latin America. These methods have been designed for different species, damage patterns, environmental conditions, and cultural practices. The likelihood that these could be transferred to Peru and work effectively without a period of adaptive research is low, so there is a high probability that expenditure of considerable funding would actually be more detrimental in the long run. This approach would also leave Peru without an ongoing research capability to detect and adjust control recommendations as pest populations respond to them. To our knowledge, there are no other agencies, public or private, with the experience, manpower, and facilities to undertake a project of this character and scope.

DIRECT & INDIRECT BENEFICIARIES

The direct beneficiaries of the project will be the AID target group of small-scale farmers--the primary producers of agricultural crops in Peru. These farmers will benefit from training programs and improved extension information and recommendations that will be developed. Indirect beneficiaries would include consumers for whom a greater food supply at lower prices could be produced. Participant government agricultural agencies will be both direct and indirect beneficiaries through staff training and through the increased credibility gained with small-scale farmers through the extension of an effective crop protection program. All categories of farms--small, large, commercial, and estate--and all organizations involved in agricultural development activities would benefit indirectly from an increased availability of technical information and from an improved ability of government agencies to introduce necessary program modifications as problems change or as new materials and methods become available.

EXTENT OF THE SPREAD EFFECT

The extent of the spread effect of this project is hard to predict at this time. The rural poor are probably the largest single group throughout Peru and probably suffer the greatest risk of limited production due to pest damage. The subsistence farmer and the small farm producer are at present minor participants in the government economy. By reducing risks and removing production limitations for these small producers, it is expected that additional persons will be brought into local economies thereby contributing to economic growth and development. There are numerous technical assistance programs in progress designed to reach the rural poor. The present proposal differs from most of these, however, in that it will recoup losses from a potential that is not now realized but could be available. It is a program of conservation, the results of which can be large while the cost should be relatively small. Equally important is the fact that the results of this project could have immediate payoff.

FINANCIAL PLAN

Estimated annual costs for the project are given. Inflation for the project period has been estimted at 30%; contingency is estimated at 10%. Budget figures are preliminary and will be more fully developed and refined in later phases of project design and development.

PROJECT DEVELOPMENT STRATEGY

This project should be developed jointly by the Denver Wildlife Research Center (DWRC), the Aid Mission, and appropriate government agencies. DWRC will be responsible for the technical and programming part of project documentation while AID will be responsible for coordination and policy formulation. Specific site selection and personnel involved will be made through consultation with the AID Mission, host government, and subsequent to review by the DWRC technical staff. Completion and submission of required project documents is anticipated in FY83 and project implementation in FY84.

Approximately 2 person-months of TDY services by DWRC technical staff members will be required for initial project development studies in Peru. Anticipated costs are approximately $13,000 to cover salaries, travel, and per diem.

POLICY OR PROGRAM ISSUES

In order to solve the rural poverty problem, farmers must, first of all, have more to sell. Increased marketable produce implies increased incomes on the farm and is likely to improve employment in processing, handling, distribution, and marketing systems. This project attempts to achieve better equity for the rural poor by lessening vertebrate pest damage so that crop losses are reduced and the farmer will realize a larger share of his potential product.

The most cost-effective methods of decreassing the loss of agricultural products to vertebrate pests will be the criteria to judge control alternatives and establish priorities. Because large segements of the technology may be adaptations of methodology developed by other AID-funded vertebrate programs, outputs should be available in a relatively shorter timer period than if the program were undertaken from a less-advanced starting point.

ENVIRONMENTAL IMPACT

Crop conservation is the critical aspect of this project. To achieve this, it is intended to reduce damage by rodent and birds in the basic agricultural crops that are predominently grown on small-scale farms. The project may have an impact on land use by curtailing undue expansion of agriculture to new uncultivated land by providing increased production from land already under cultivation. Successful management of vertebrate pests should result in greater food production and possibly in diversity in food types. Because rodents are often reservoirs or vectors of disease, affective rodent control will help reduce the incidence of infirmitives frequently transmitted by these pests. In Latin America, the relatively common and hphazard use of highly toxic persistent chemicals for rodent and bird control inhances the potential for accidental poisoning of humans and livestock. This project will discourage such hazardous and generally ineffective approaches in general. The project will have minimal adverse environmental impacts and a potential for reducing existing harmful practices while contributing to an improved standard of health and nutrition of the target beneficiaries.

IMPACT ON WOMEN

Women will benefit from this project in several ways. Women and other family members are actively involved in farming activities and marketing of small farm crops in Peru and will benefit from increased food production and income. Additionally, women will play an active role in the execution of the project itself. Employment opportunities will be available not only in clerical positions traditionally open to women, but also in technical positions. Women biologists are currently active in related field programs in

the Philippines, Bangladesh, and Haiti.

ANNEX G

THE SOYBEAN INSECT PEST MANAGEMENT PROGRAM IN THE SELVA ALTA OF PERU

THE SOYBEAN INSECT PEST MANAGEMENT PROGRAM IN THE SELVA ALTA OF PERU

by

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RECOMMENDATIONS

The SOY/IPM program research team met as a working group at the Estación Experimental Vista Florida, Chiclayo, Perú, 2-5 March 1981, to review progress made in the program, initiate the final report, and make recommendations relative to the program for the future. The unanimous recommendations of the working group composed of Dr. Irwin, Ings. Avalos, Chicoma, Chiroque, and Cárdenas follow.

1. Continuance of the SOY/IPM program

Because the SOY/IPM program can serve the soybean grower in his ever increasing need to protect soybean fields from disastrous losses due to insect attacks, because the SOY/IPM program has decreased and could continue to lessen the use of chemical pesticides dangerous to human health and very costly to the small farmer, and because the SOY/IPM program serves a pioneer role in the development of integrated crop protection in annual food crops in Peru that in the future could easily and beneficially be expanded to include other localities, other protection disciplines, and other crops, we emphatically recommend that funds be secured to guarantee the successful continuance and expansion of the SOY/IPM program.

2. Flexibility of the SOY/IPM program and future linkages

The SOY/IPM program is flexible and adaptable to many situations. New projects that develop should build onto the existing framework of the SOY/IPM program in aspects of crop protection. It is our feeling that the SOY/IPM program should link strongly with the AID/Peru-sponsored research, education, and extension project (AID/LAC/P-042) as well as the AID/Peru sponsored development project for subtropical lands in the Huallaga Central (AID-DIC/P-2278). It should also link with protection aspects of International Center programs, especially of CIAT, and with the upcoming Title XII Integrated Crop Protection CRSP. In the latter instance, the SOY/IPM program could serve as a model for an expanded integrated crop protection program in the selva alta of Peru involving many crops and many protection disciplines (AID/SAN-G-0203, May 1980). National programs could also incorporate the tenets and practices of the SOY/IPM program in the protection aspects of the their crop-oriented projects. From all conceivable viewpoints, the SOY/IPM program is flexible and adaptable, and we strongly recommend that this program be linked with and built into as many projects as possible.

3. Emphasis on technology transfer

The technology package, herein called the basic SOY/IPM package, has undergone its first major revision based on data accumulated by researchers in the selva alta of Peru during the 1979 and 1980 soybean growing seasons. To date, unfortunately, very little effort has been exerted on implementing the basic SOY/IPM package at the grower level in the agricultural sector. Many crop protection projects hold off the implementation phase until nearly all factors are well understood. In developing this package, we have taken the extraordinary step of assembling what is known so that all available technology can be used by growers to help decrease their losses and optimize returns. Our approach has been that any reliable information is better than none. We forcefully recommend that, within this SOY/IPM program, major emphasis be placed on the transference of technology to soybean growers and Perito Agricolas. The package must be

implemented at the grower level. Within this overview, the following aspects should be considered.

a. Subprogram initiated to concentrate on technology transfer

An energetic and persistent subprogram should be established in the Jaén-Bagua area that concentrates on technology transfer. An immediate and vigorous subprogram is vitally needed in this area because of the concentration of soybean production, because insect pests are a major constraint to soybean production, and because pesticide salesmen are pressuring uninformed growers to over-apply pesticides, a very costly and dangerous proposition. Since soybean is currently rotated with rice, a similar intermeshing program should be established for rice pests in the area. The soybean subprogram should be initiated in July 1981 and should be a coordinated effort among scientists. Ing. Carlos Rojas, extension specialist in the Jaen area, should coordinate the effort with local support from entomologist, Ing. Juan Chiroque. Ings. Avalos and Chicoma should visit the Jaén area in July, bringing with them data sheets, ground cloths, and the basic SOY/IPM package. Initially, ten or so soybean growers that are leaders in the community should be contacted and the basic package used on their crops. A massive publicity campaign should follow the season's harvest extolling the virtues of the SOY/IPM package. This should include some local radio broadcasts.

b. Publication of basic SOY/IPM package

A high quality technical bulletin on the basic SOY/IPM package should be published in sufficient numbers, e.g. 5,000, to inundate the soybean growers and Perito Agricolas of the selva alta, especially the Jaén-Bagua area, with basic information on the insect pest management program. Included should be information on how to tell the pest and beneficial species, how to monitor their populations, at what population density or damage incidence they should be controlled by chemicals, which chemicals to use, at which dosages, and how to apply them. The bulletin should also contain some elementary information on the concepts of pest management. In fact such a bulletin could be based on information contained in this report. Growers and Perito Agricolas will respect and appreciate such a publication much more if it were printed on quality paper with color photographs, and artfully designed. If properly written, such a publication would greatly help the growers in their battles with soybean pests and with the continual pressures exerted by insecticide salesmen.

c. Students participate in the basic SOY/IPM package

Because the extension specialists and Perito Agricolas are grossly overcommitted (too many crops, too many growers to advise, too many activities), every effort must be exerted to secure additional expertise to advise soybean growers on the basic SOY/IPM package. After careful consideration we recommend that plant protection students studying in various agricultural universities of Peru (e.g.,Universidad Nacional Agraria, Universidad Nacional Pedro Ruiz Gallo) be given the opportunity to participate in the SOY/IPM package, perhaps during the summer vacation. Sufficient funding should be given these students to allow them to become involved with no personal economic loss. A program of this nature could

serve three aims: it will lessen the load currently on the Perito Agricolas and improve the transfer of technology; students will learn first hand the basic concepts and practices of a working pest management program and; upon completion of a degree and accepting a position, the former students will take this new technology with them and begin to broaden the base of pest management in Peru.

d. Modify basic SOY/IPM package for soybean in northern coastal Peru

Because the major area of soybean production is the northern coast of Peru, especially around Tumbes and Piura, we recommend that this basic SOY/IPM package be modified and made available to soybean growers in the northern coastal area.

4. Research effort on SOY/IPM should concentrate on PHASE IV

The research aspects of the SOY/IPM program have been strong and healthy, thanks largely to several dedicated scientists. We strongly recommend that the research activities continue, and that emphasis be placed on PHASE IV whereby tactics other than the use of pesticides be studied to maintain key pest population densities from reaching economic thresholds. As a portion of this recommendation, we propose the following.

a. Funding should be secured for the timely publication of research results in scholarly journals

b. Reward efforts by researchers

Enthusiastic researchers must be rewarded through salary merit incentives and grants to visit areas of importance for the advancement of the SOY/IPM program. In the latter regard, for example, we recommend that Ing. Feliciano Avalos, National Coordinator of the SOY/IPM program, be sent to Brazil to absorb the advancements in soybean pest management technology transfer and research that are being made in Londrina. We also recommend that Ing. Felix Chicoma, head of plant protection at Vista Florida and subcoordinator of the SOY/IPM program for the Jaen-Bagua area, be sent to the University of Illinois at Urbana-Champaign during one soybean growing season (May15-October 15) to work with the INTSOY entomology team and attend the soybean production short course. These activities are vital to the success of the overall SOY/IPM program.

c. Training for SOY/IPM program collaborators

Training courses have played an important role in the preparation of researchers to carry out the research activities of the SOY/IPM program. Every effort must be made to encourage researchers and extension specialists to attend training courses, both in country and out. One excellent source of training are the International Agricultural Research Centers.

ACKNOWLEDGEMENTS

A program as extensive and intensive as SOY/IPM, by necessity, involves the cooperation and coordination of several institutions and persons. The cooperating institutions include the Instituto Nacional de Investigacion Agropecuaria (INIA, now INIPA), the Ministerio de Agricultura (MA), the United States Agency for International Development, Peruvian Mission (AID/Peru), and the International Soybean Program of the University of Illinois and the University of Puerto Rico (INTSOY). The aims and intent of the SOY/IPM program have been greatly advanced by several intensive courses on integrated crop protection sponsored by the Consortium for Integrated Crop Protection (CICP), the Universidad Nacional Agraria (UNA), AID/Peru, and INTSOY.

The overall program was coordinated by Ing. Rodolfo Vargas S. of INIA who attempted to maintain a solid balance between research and extension activities. Ing. Rufino Montalvo, project coordinator for bean and soybean, INIA, offered valuable assistance. To both of these scientists we offer our sincere appreciation.

The extension aspects of this program were under the guidance of the Ministry of Agriculture (MA) and coordinated by Ing. Ricardo Villamonte. Extension specialists in each of the regions include Ing. José González and Ing. Carlos Rojas of Jaén-Bagua, Ing. Vito Yariñgano of Tarapoto, and Ing. Nicolas Valencia and Ing. Antonino Lermo of Satipo. We owe our continued gratitude to these extension specialists.

The research efforts of the program were coordinated by Ing. Feliciano Avalos with support from Ing. Félix Chicoma in the Jaén-Bagua area. Entomologists in each of the participating areas contributed immensely to the success of the program. These constitute some of the authors of this report: Ing. Pedro Alcalá of Satipo and Pichanaki, Ing. Juan Chiroque of Bagua, Ing. Edison Cárdenas of Tarapoto.

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INTRODUCTION

The soybean insect pest management program (SOY/IPM) is an integral part of a larger soybean production/utilization project. SOY/IPM is a tool, and as such must work within a larger matrix that includes agronomic practices, marketing, economic and social factors. SOY/IPM can only serve the grower if the entire matrix is healthy and functioning properly.

The major purpose of the SOY/IPM program is to develop strategies to protect soybean from yield-reducing attacks by several complexes of insect pests and, at the same time, to minimize the use of chemical pesticides, thereby reducing the health hazards associated with these poisonous chemicals, lowering the risk of development of resistance by various pest species to these chemicals, reducing the possibility of secondary pest outbreaks due to chemicals eliminating natural enemies, and lowering the cost associated with crop protection because these chemicals are extremely costly in Peru.

A crop failure due to pests often discourages the grower from replanting the crop the following season. Similarly, frequent applications of costly chemicals can so reduce net profits that the grower is discouraged from planting the crop again. A balance between too little crop care and too great of a reliance on pesticides is essential to proper crop production and the SOY/IPM program provides the methodology necessary to achieve this important balance.

The SOY/IPM program is laying a foundation of crop protection management that has elements and principles adaptable to other crops and other protection disciplines. It may be possible in the future to interface the SOY/IPM program with other Peruvian programs involving crop protection. Such projects as the AID Sponsored Research, Education and Extension program and the Title XII program on Integrated Crop Protection could be greatly strengthened by adjusting the SOY/IPM to meet these developing projects.

SOY/IPM was initiated in 1979 to backstop the larger soybean production and utilization project sponsored by AID/Peru and contracted to INTSOY. SOY/IPM was originally conceived as a national program to coordinate soybean protection in all parts of Peru, but because AID/Peru, INIA and MA have placed a heavy emphasis on developing the agriculture sector of the selva alta, the SOY/IPM program has concentrated in three areas of the selva alta: Bagua-Jaén (78°36'W., 5°40'S.), Tarapoto (76°20'W., 6°40'S.), and Satipo (74°40'W., 11°20'S.). Bagua-Jaén is a fairly dry region with soybean following rice; Tarapoto is intermediate, and Satipo has heavy rainfall and a very tropical climate. These differences, as can be seen below, are reflected in different key pest complexes in three parts of the selva alta.

PHASE I: THE BASIC SOY/IPM PACKAGE

The tenets inherent in pest management are incorporated into the overall SOY/IPM program. This program has several phases of development, the first of which is the construction of a basic pest management package. Such a package was initiated to give growers immediate access to technology that currently exists from experiments conducted on soybean pests in the United States of America and in Brazil as well as information that has been gathered in Peru on important soybean pests in other crops such as beans. Thus, the basic package has the advantages of setting limits on pest population suppression at the outset and begins to acquaint soybean growers and extension specialists with the concepts and practices of pest management through the implementation of supervised control procedures. By providing an interim control strategy for soybean insect pests, albeit a largely chemically oriented strategy, valuable time is gained during which research efforts can focus on other phases of the SOY/IPM program. The basic SOY/IPM package identifies several pests, and these are detailed below.

Problem Identification

A roster of pest species, generated by entomologists and extension specialists working in soybean in Peru, included all known and presumed pests of soybean. The roster (Table 1) became the foundation upon which the basic SOY/IPM package was constructed.

Monitoring Population Densities of Pest Species

A sampling plan to monitor insect pest densities and damage incidence in grower fields was developed as a portion of the basic SOY/IPM package. The sampling methodology had to be uncomplicated and applicable to a variety of pest species. Three types of sampling procedures were developed: 1) the ground cloth, 2) observation of plant parts, and 3) estimation of percentage defoliation.

The ground cloth (Fig. 1) was used to measure population densities of leaf feeding Lepidoptera larvae, leaf feeding Chrysomelidae adults, and seed sucking stink bugs. Five two-meter ground cloth samples were taken in five portions of a grower soybean field every week, as diagrammed (Fig. 2). A data sheet (Fig. 3) was to be filled out for each field each week.

Plant part observations were to include five plants from each of the five portions of the soybean field indicated in the diagram (Fig. 2). The number of pods and growing shoots were to be noted on each identified plant and, upon dissection, the number of Lepidoptera larvae feeding on seeds in the pod and larvae boring into shoots were to be tabulated. Stems of each plant were also to be dissected and the number of *Elasmopalpus lignoselus* and *Grammopsoides rufipes* were to be tabulated. Also, the number of clumps of matted leaves per plant, an indication of the abundance of *Hedylepta indicata* larvae, was to be tabulated.

Finally, the percentage defoliation, based on a diagram (Fig. 4), was to be estimated for each of the five plants randomly isolated from the five sampling areas of the soybean field. These percentages were also to be noted on the data sheets (Fig. 3). A field data register (Fig. 5) was also to be maintained for each soybean field.

TABLE 1. BASIC SOY/IPM PACKAGE, ASSEMBLED.

NOMBRE		DAÑO ECONOMICO			INSECTICIDAS Y RECOMENDACIONES (gramos/ha)	
común	científico	estado	No/M surco	daño	Ingrediente activo	Producto comercial
Gusano defoliadores	Anticarsia gemmatalis					
Caballada		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 cualquier 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

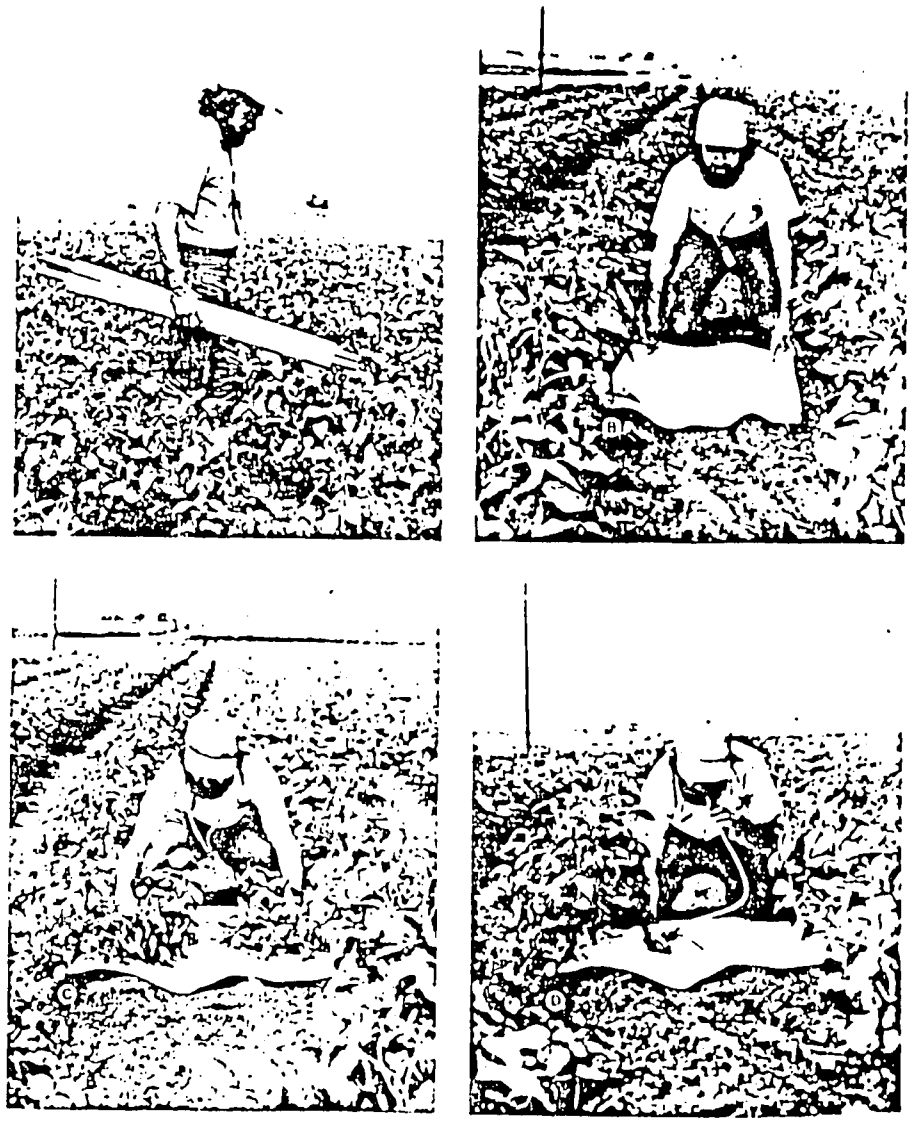


Figure 1 . Ground cloth sampling method. (A) Approaching sample site with ground cloth rolled; (B) Unrolled ground cloth spread between two rows of soybean; (C) Bending and shaking plants on the two adjacent rows; (D) Aspirating specimens for identification.

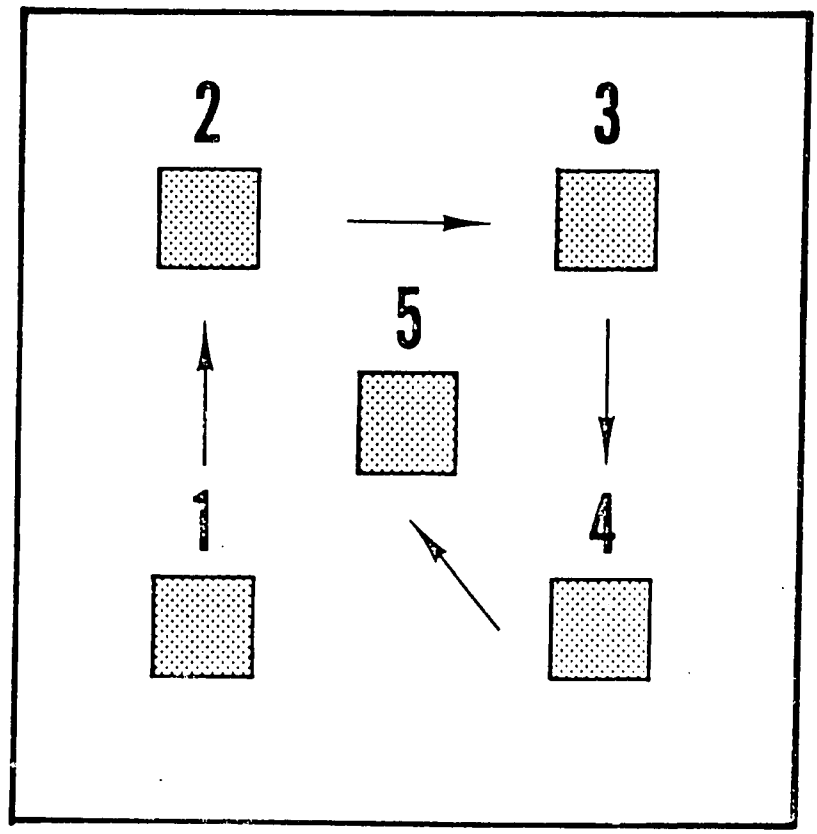


Figure 2. Diagram of sampling procedures for the basic SOY/IPM package and the population dynamics study. One should proceed clockwise taking the required number of samples in each of the five sections illustrated. For the basic SOY/IPM package, the area should be approximately 1 ha; for the population dynamics study the field area is 30 x 30 m.

Número de campo:_____

CONTROL SUPERVISADO DE PLAGAS DE LA SOYA

HOJA DE CONTADA

Evaluador:_____

Estado de plantas: V_____ R_____

Temperatura: _____ °C

Fecha: _____
año mes día hora

Viento: Calma/medio/fuerte.
Clima : claro/nublado/lluvioso

Agricultor: _____

Registro de 5 muestras por sección, 25 muestras en total	SECCIONES					Total	Promedio (por metro o por planta).	Daño
	I	II	III	IV	V			
I. En tela de lona								
(5 muestras por sección)								
Escarabajo de la hoja								
Chinches								
Caballada								
Gusano medidor								
II. En plantas								
(5 plantas por sección)								
a) Vainas								
No.total de vainas								
vainas con barreno								
b) Brotes								
No. total de brotes								
brotes con barreno								
c) Tallos								
con Elasmopalpus								
con Cerambycidos								
d) Hojas								
Hojas pegadas								

Figure 3. Data sheet for basic SOY/IPM package.

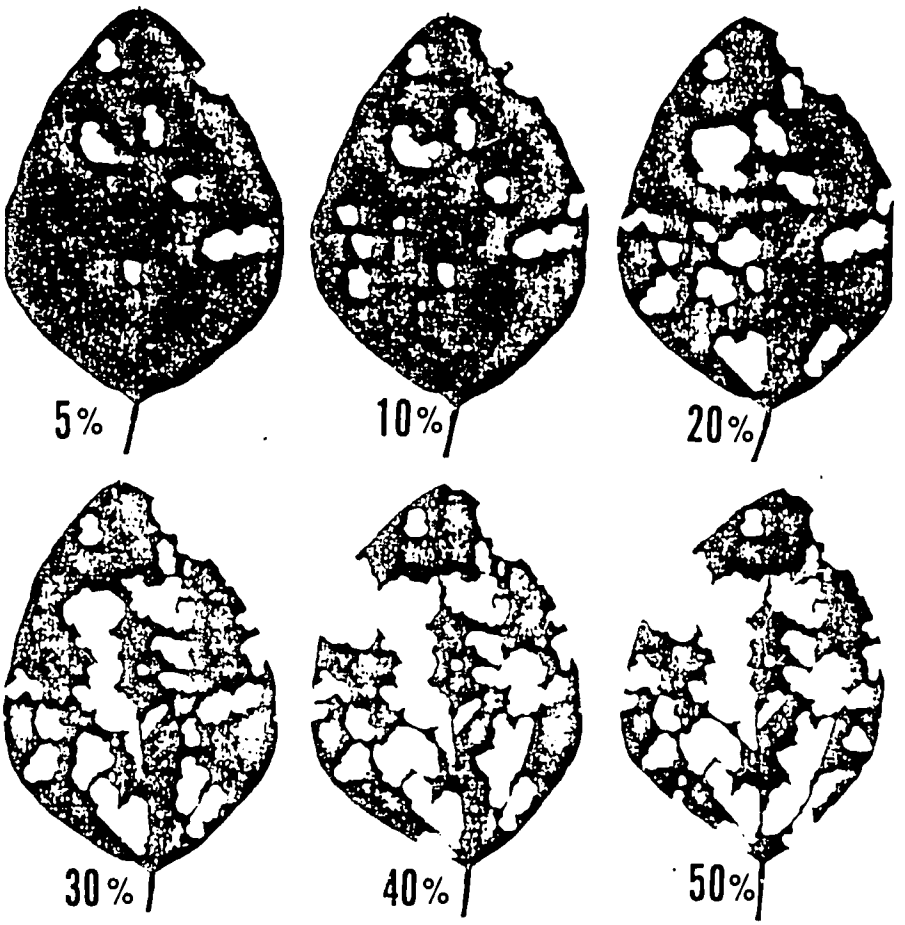


Figure 4. Sample of soybean leaflets with various percentages of the blade removed by insect feeding.

CONTROL SUPERVISADO DE PLAGAS DE LA SOYA

Evaluador : .....

Campo: .....

Localidad: .....

Departamento: .....

Campaña: Verano/Invierno:

Variedad: .....

Fertilización:.. .....Kg/Ha.

Agricultor : .....

Extensión :.....Has.

Rendimiento :.....Kg/Ha.

Fecha de siembra: ..... año mes día

Fecha de cosecha: ..... año mes día

Inoculación : .....

Altitud ..... m.s.n.m.

REGISTRO DE CAMPO

Fecha	Desarrollo Vegetativo de la planta	PLAGAS Y DAÑOS																							Aplicaciones de Pesticidas y Dosis Usada	Labores Culturales Realizadas
		Escarabajo de la hoja			Caballa		Gusano medidor		Picador de Tallo		Cerambicido		Hedylepta				Araña roja	Chinches	Afidos	Acaro del Tostado						
		Ad	Lv	Dñ	Lv	Dñ	Lv	Dñ	Lv	Dñ	Lv	Dñ	Lv	Dñ			Ad			Dñ						

Figure 5. Field data register.

Establishing First Estimate Economic Thresholds

At the inception of the SOY/IPM program a table of approximate economic, thresholds was set down based mainly on data of economic injury levels for major pest species in the USA and Brazil. Where data from these sources were lacking, best estimates were attained by noting present-day practices of insecticide application on soybean and bean. The resulting thresholds are noted in the assembled chart (Table 1).

Chemical Control

The initial SOY/IPM package was based on the use of chemical applications if the population density of a given pest surpassed economic thresholds. A search of the literature provided reasonable data on applicable chemicals and minimal dosages for each of the several pest species. Most of these were derived from research conducted on soybean, but a few were adopted from data derived from studies on beans. The resulting chemicals and dosages are listed on the assembled chart (Table 1).

Assembling the Basic SOY/IPM Package

A chart (Table 1) was prepared that united information on the pest species, their estimated economic thresholds, and chemical control recommendations. This was circulated widely to extension personnel in the three zones. Ground cloths and data sheets were also provided. It was understood that the extension activities were to be under the control of MA extension specialists in each area and that these specialists would rely on the associated entomologists for backup support. The area of Bagua initially was to focus on 10 grower fields. The area of Satipo was to focus on 5 grower fields.

To date very little has been done to implement the basic SOY/IPM package at the grower level. There are several reasons for this, but perhaps the most important is the lack of personnel to transfer the technology. The few extension specialists have, up to now, had so many duties that they were unable to carry this additional load in a satisfactory manner. Ing. Antonino Lermo was able to evaluate two grower fields during the 1980 July-October growing season in the Satipo area. In neither field did any of the pest species approach economic threshold levels. And, consequently, insecticides were not applied in either field.

Efforts to reinforce this aspect of the program are manditory if the program as a whole is to succeed.

PHASE II: POPULATION DYNAMICS

The Research Plan

The practice of pest management is based firmly in the principles of ecology. To understand the points in the life cycles of the pests most susceptible to control and manipulation, what control measures to use to lower pest population densities, the role of natural enemies in the population regulation of pest species, and levels of pest population densities tolerable by soybean with minimal resulting yield loss: These phenomena must be solidly founded on an understanding of ecology and pest biology. Many factors affect the population dynamics of pest species; location and its ambient climate is perhaps the most

important. A study of the population dynamics of pest species in relation to crop phenology at several localities in Peru was initiated to provide the basic background necessary to advance the SOY/IPM program in a sound and logical manner. This series of experiments served as the basis for modifying the SOY/IPM package (see PHASE III).

Objective

The objective of Phase II was to establish base-line levels of arthropod pests and their natural enemies in soybean fields in the selva alta, to determine which pests and natural enemies are important in which production areas, to understand the basic population fluctuations of various species throughout two soybean growing seasons, and to link these dynamic aspects with various growth stages of the crop.

Plan Implementation

This set of experiments was conducted in three sites in the selva alta (Bagua, Pichanaki near Satipo, and Tarapoto) and in one site in the central coast (La Molina). The sampling procedures needed for this set of experiments were more rigorous and exacting than that developed for the basic SOY/IPM package.

The experiment used soybean cv. Improved Pelican or Jupiter planted in 75cm rows at the normal planting time for the crop. The plots measured 30 x 30m. No insecticides were used on the plots. Each plot was sampled at least 5 times during the growing season, at growth stages V2, V6, R3, R5, and R7, or approximately every second week after planting. Sampling was done at the same time each sampling day, around 10am. Three types of samplings were used on each plot every sampling date: 1) plant samples, 2) ground cloth, and 3) sweep net, in that order. The plots were divided into five parts (see Fig. 2) and in each part five plants were viewed at random. From each of these plants, five upper and five lower leaflets were examined and the number of pests and beneficials recorded. The percentage defoliation was also noted. The plant shoots were dissected and the number and kind of pests recorded. Similarly, the stem was cut open and the pests recorded. Five ground cloth samples were taken from each part of the plot and the insect species and numbers were noted. A single sweep net sample consisting of 25 sweeps was taken in each of the five portions of the plot. All of the equipment necessary to carry out this experiment was provided for each investigator. Originally, soil samples were also to be taken, but the sampling devices took too long to construct to be of any use.

Results of the Population Dynamics Study

Several aspects of the population dynamics of pests and beneficials study were undertaken. At the Bagua and Satipo (Pichanaki) sites we looked for consistency in population buildups between years. At the Tarapoto site we looked at population levels of key and potential pests during two growing seasons of the same year. We also studied the population dynamics of key pests and beneficials in a coastal site, at La Molina. From the data gathered at each site, we took a comparative look at the key pests in the three selva alta sites. We realize that the study has been in progress only two years, but we feel enough information has been gathered to make some tentative conclusions.

The Bagua site. More information has been gathered from this site than from any other. Population studies of Pseudoplusia includens (Fig. 6) show consistent buildups of larvae at nearly the same plant growth stages during the 1979 and 1980 growing seasons. Peak numbers of larvae per meter of row were between growth stage V5 and R6, the point during plant development most critical to defoliation. P. includens is a key pest in the Bagua area.

Cerotoma arcuata, another foliage feeder, had nearly identical population fluctuations and peaks during the two growing seasons (Fig. 7). Their peak densities occurred during pod fill (R2-R6) when they are capable of causing the most damage, but numbers were rather low, approaching 1.5 adult per meter of row at peak density. This is considerably below the established economic threshold.

Aphids rarely colonize soybean in the western hemisphere. However, we have noted that Aphis craccivora, the cowpea aphid, occasionally colonizes when the plants are young, especially in the vegetative growth stages (V1-R1). In Bagua during the 1980 growing season, colonies reached rather high levels (up to 10 aphids per trifoliolate) at growth stage V6 (Fig. 8). Populations were nearly two times denser on upper than on lower trifoliolates (Fig. 8). Economic thresholds have not been established for this pest, but predation pressure from coccinellidae (Fig. 12) evidently reduced aphid populations in soybean fields. Adults of Aphis craccivora are efficient vectors of several soybean viruses, including soybean mosaic virus.

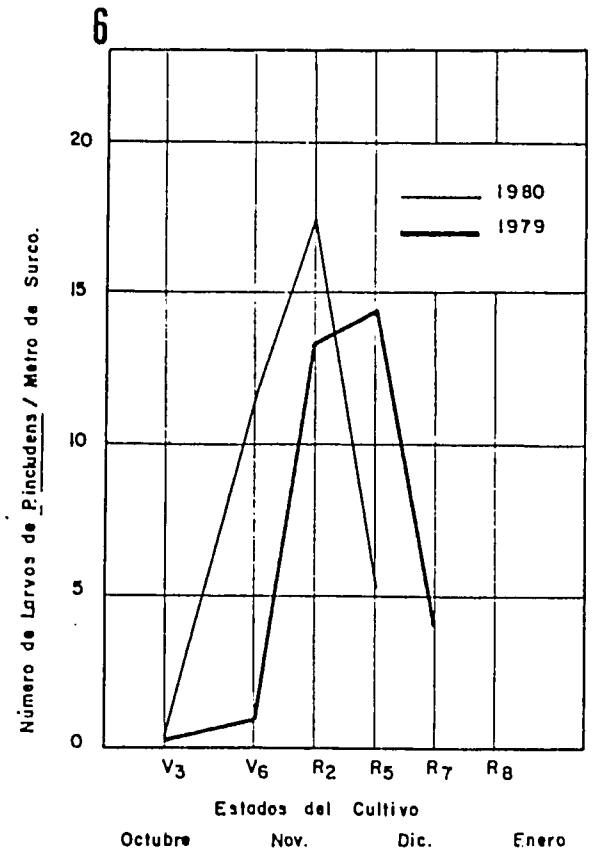
Piezodorus guildinii population densities appeared well timed with plant phenology, only increasing their numbers during pod fill and seed maturation (Fig. 9). This increase occurred at the same time each year, and both years the population densities surpassed the established economic thresholds (Fig. 9). Indeed, Piezodorus guildinii appears to be a key pest in the Bagua area.

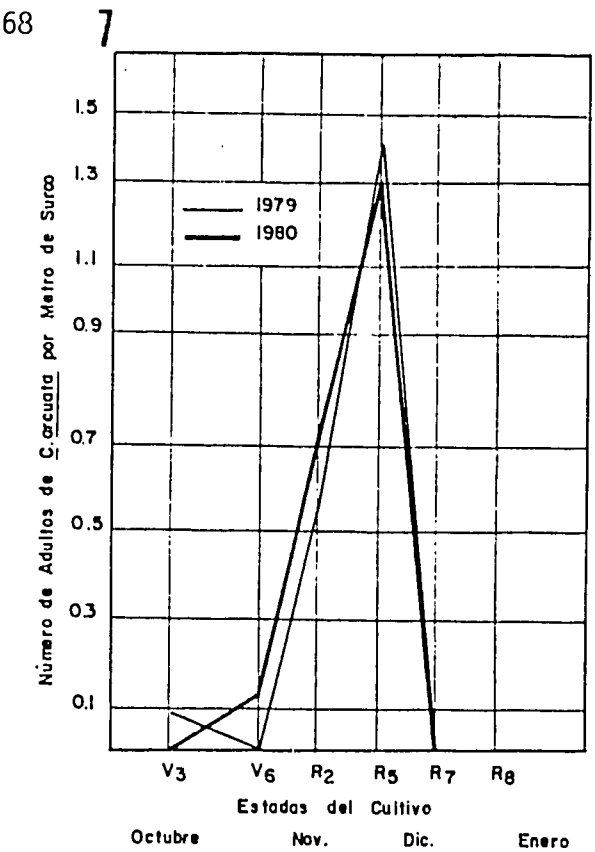
Other minor and potential pests were monitored at the Bagua site including leafhoppers, Empoasca sp. (Fig. 10), and thrips, probably Frankliniella sp. (Fig. 11). Neither of these potential pests apparently approached damaging numbers, but their population increases and declines were rather rapid, and the curves appeared similar each year (Figs. 10,11).

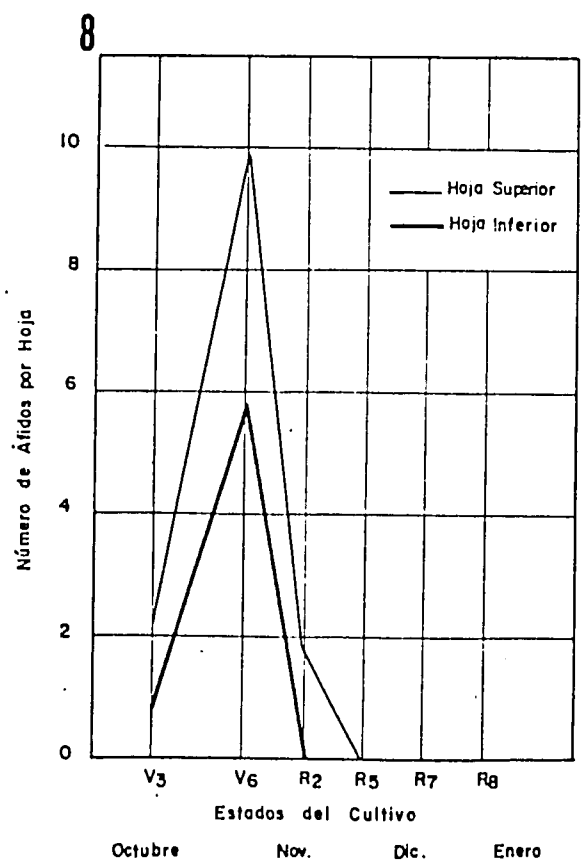
One additional chrysomelid leaf-feeding beetle was abundant in the plots at Bagua, but only during the 1980 season. This potential pest, Myochrous sp., should be watched in the future for numbers were nearly half the estimated economic threshold (Fig. 14).

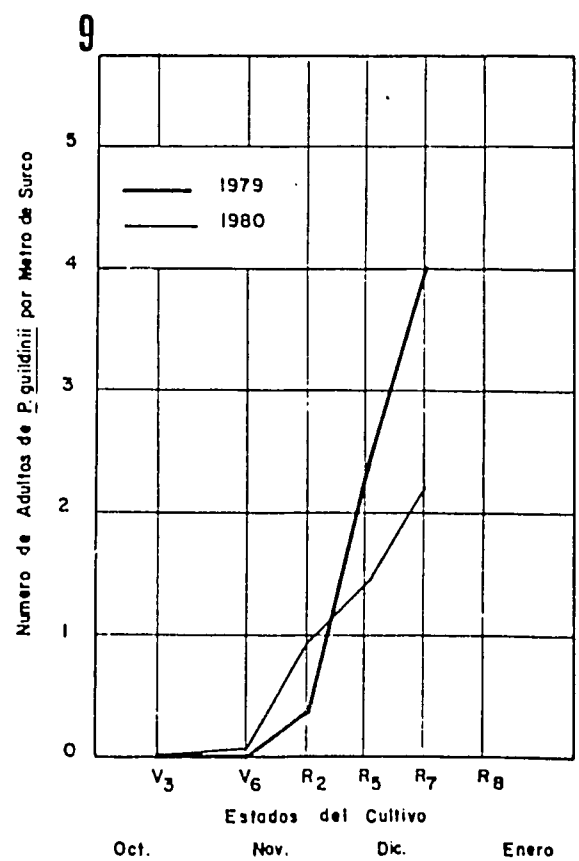
Natural enemies were also monitored, and it appears as though the increase in numbers of coccinellids (Fig. 12) may have been in response to the buildup of aphids in the field (Fig. 8). Spiders are general predators and their numbers were encouragingly great in the soybean plots (Fig. 13).

The Tarapoto site. Soybeans are regularly planted in the Tarapoto region twice a year. The major pest species buildups varied in our experimental plots depending upon planting time, at least during 1980. The key lepidopterous defoliator in the Tarapoto region is Anticarsia sp.,

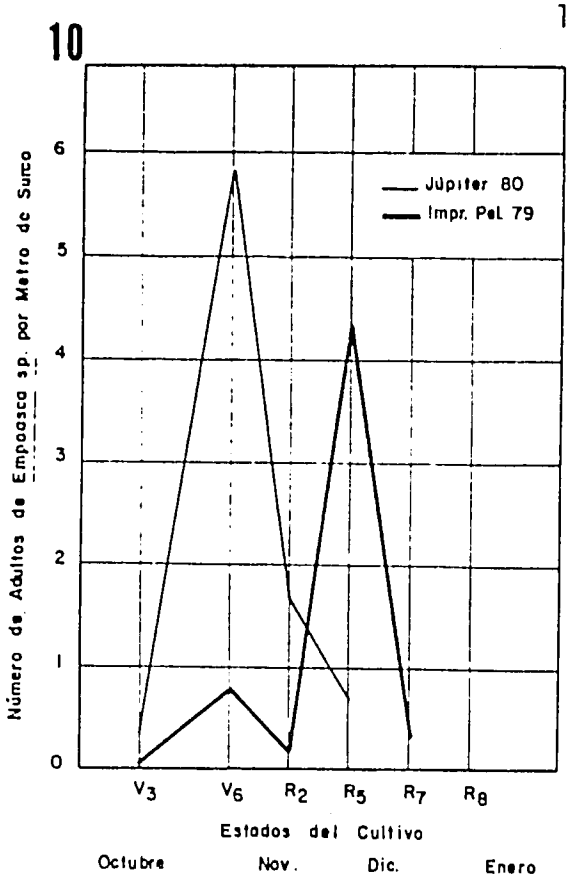


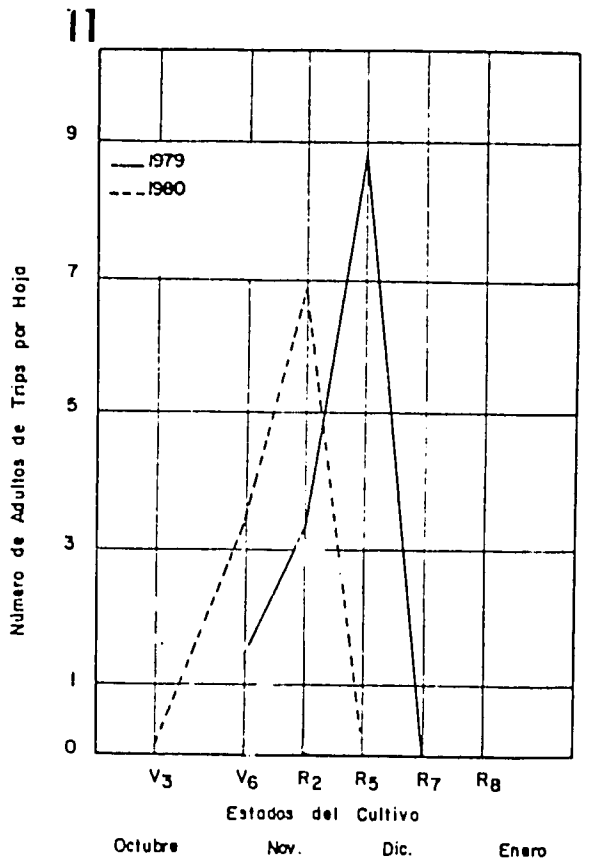


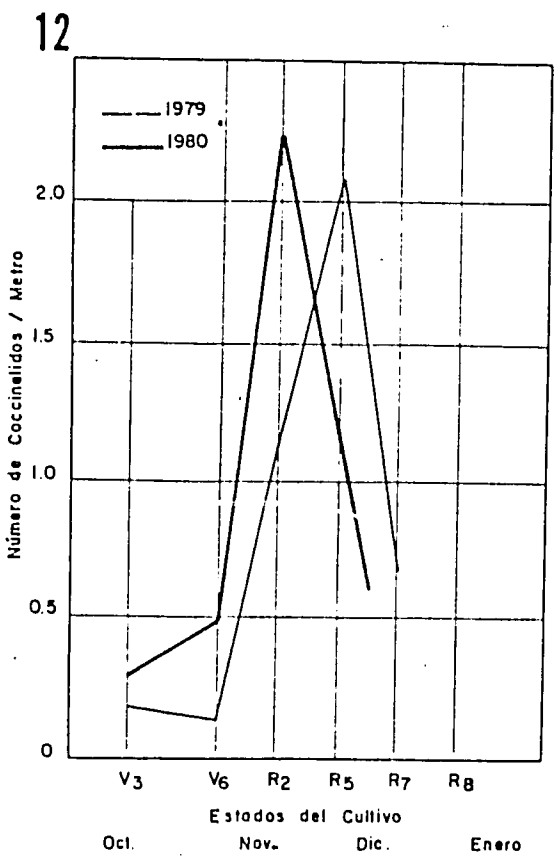


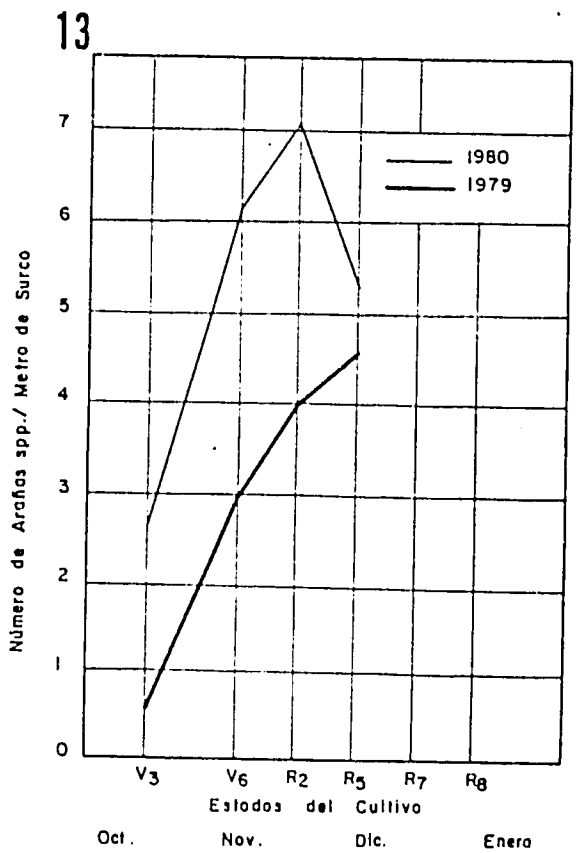


Figs. 6-9. Number of species in soybean plots, Bagua, Peru. 1979 season with cv. Improved Pelican planted 2 October and harvested 17 January 1980. 1980 season with cv. Jupiter planted 3 October and harvested 23 January 1981. 6. Larvae of Pseudoplusia includens per meter of row. 7. Adult Cerotoma arcuata per meter of row. 8. Total aphids, Aphis craccivora per trifoliolate during the 1980 season on upper and lower leaves. 9. Total Piezodorus guildinii per meter of row.









Figs. 10-13. Number of pest and beneficial species in soybean plots, Bagua, Peru. 1979 season with cv. Improved Pelican planted 2 October and harvested 17 January 1980. 1980 season with cv. Jupiter planted 3 October and harvested 23 January 1981. 10. Total Empoasca sp. (probably krameri) per meter of row. 11. Total thrips, Frankliniella sp., per lower trifoliolate. 12. Coccinellidae specimens per meter of row. 13. Spiders per meter of row.

probably gemmatalis although two species have been identified. Pseudoplusia includens was not an important pest during the 1980 growing seasons. Population levels of Anticarsia sp. remained low in the experimental plots (Fig. 15) but grower fields had densities approaching 40 larvae per meter of row.

Adult chrysomelid leaf-feeding beetles were not abundant in the plots during either planting (Fig. 16), but it is interesting to note that the population density during the second planting was twice that of the first (Fig. 16), while the population density of Anticarsia during the first planting was twice that of the second (Fig. 15). The complex of leaf-feeding Chrysomelidae was composed primarily of Cerotoma arcuata, Diabrotica speciosa, Myochrous sp., and Colaspis sp. Together they did not approach the established economic threshold during any part of soybean development. Similarly, in grower fields, these leaf beetles seldom attained economic threshold levels.

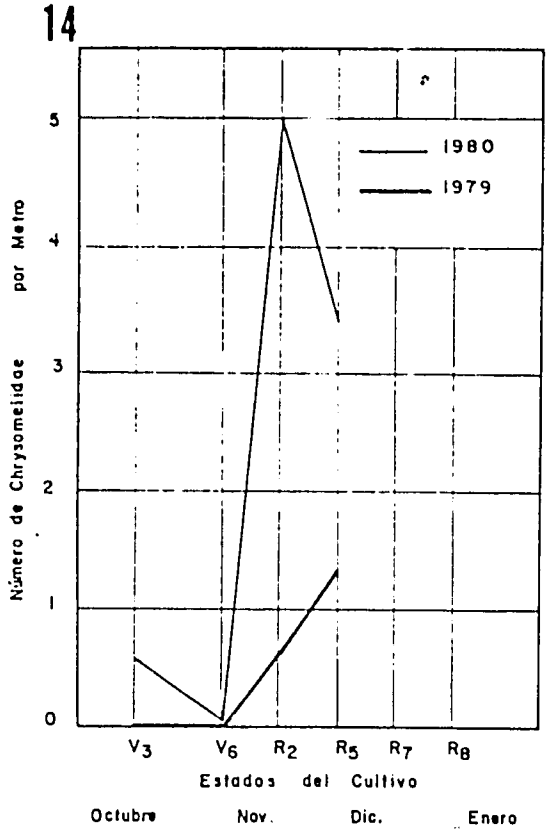
Two species of stink bugs seem important in the Tarapoto area: Piezodorus guildinii is the most abundant and Acrosternum sp. is less abundant. Studies of the population density of P. guildinii during the two parts of the 1980 growing season reveal that the second planting produced densities approximately 10 fold larger than the first (Fig. 17). This indicates that the first planting date, in March, may be preferable for avoiding seed quality problems and could be valuable for the production of a seed increase crop. Again, the density of P. guildinii increased greatly during the seed fill and seed maturation stages of soybean development. In the experimental plot, the stink bug population never reached established economic thresholds, but in grower fields the threshold was often surpassed. The stink bug complex, especially P. guildinii, is of a definite key pest status in the Tarapoto region.

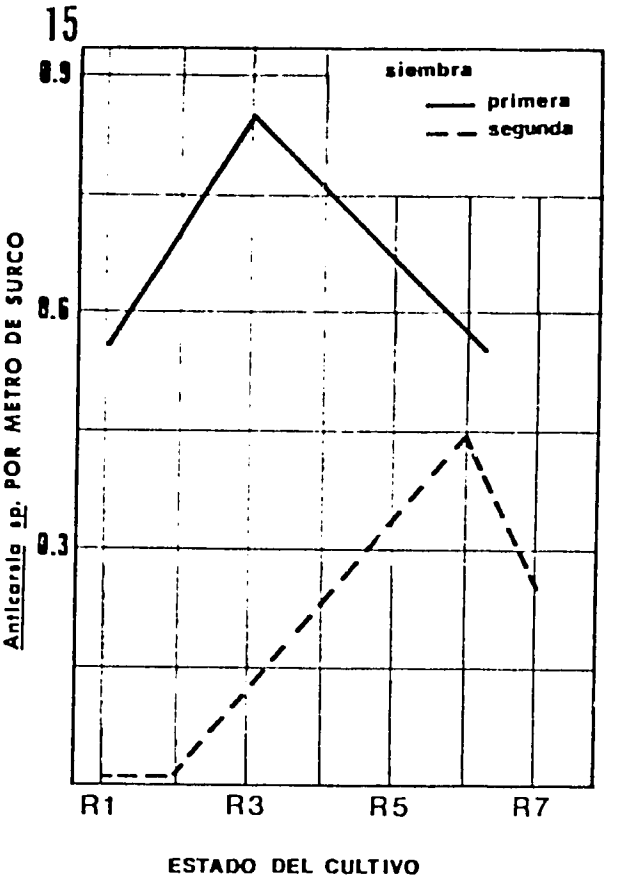
The Satipo or Pichanaki site. The site is considerably more humid than the former two. Anticarsia gemmatalis has not been observed in the area and the other major lepidopterous defoliator, Pseudoplusia includens, is not very abundant. In a two-year study, the timing and abundance of P. includens were relatively consistent with respect to the growth stages of soybean (Fig. 18). But each year the peak level reached was only 1/40 the established economic threshold.

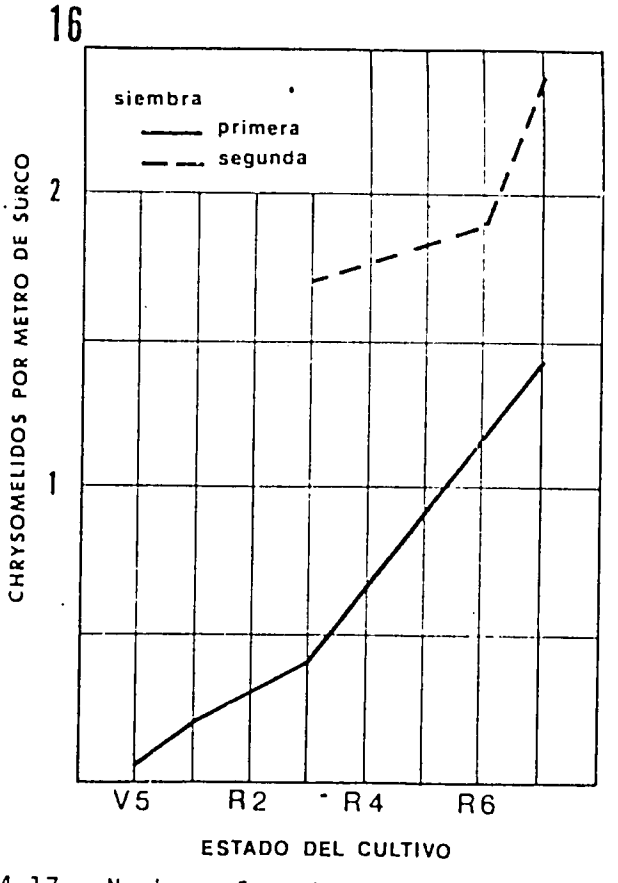
Cerotoma arcuata is the major defoliator in the Satipo area and counts of more than 20 per meter of row are known from grower fields. In the experimental plot in Pichanaki, populations peaked at fewer than 5 per meter of row but were very consistent among years (Fig. 19). Indeed, this species represents a key pest in the Satipo region.

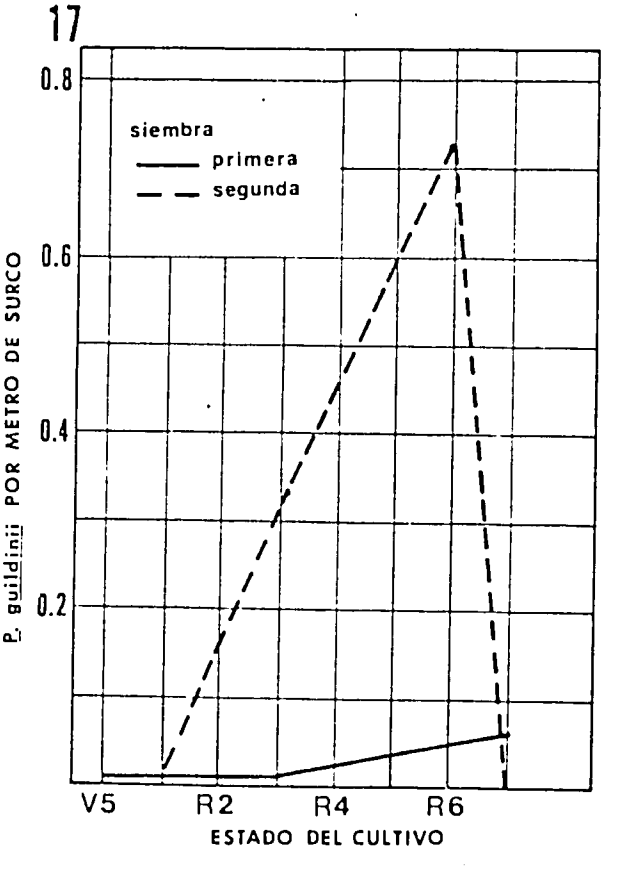
Aphis craccivora was found consistently in the plots during the early growth stages (V2-V7) in 1979 and was found later and much less abundantly in 1980 (Fig. 20). Populations in Satipo did not approach those of Bagua (Fig. 8). This is a potential pest but of no immediate concern in any of the areas sampled.

Piezodorus guildinii established and increased its population densities at the same time relative to soybean growth each year (Fig. 21). Even in the experimental plots, the established economic threshold was surpassed in 1979 and approached in 1980. This species is a key pest in the Satipo area.

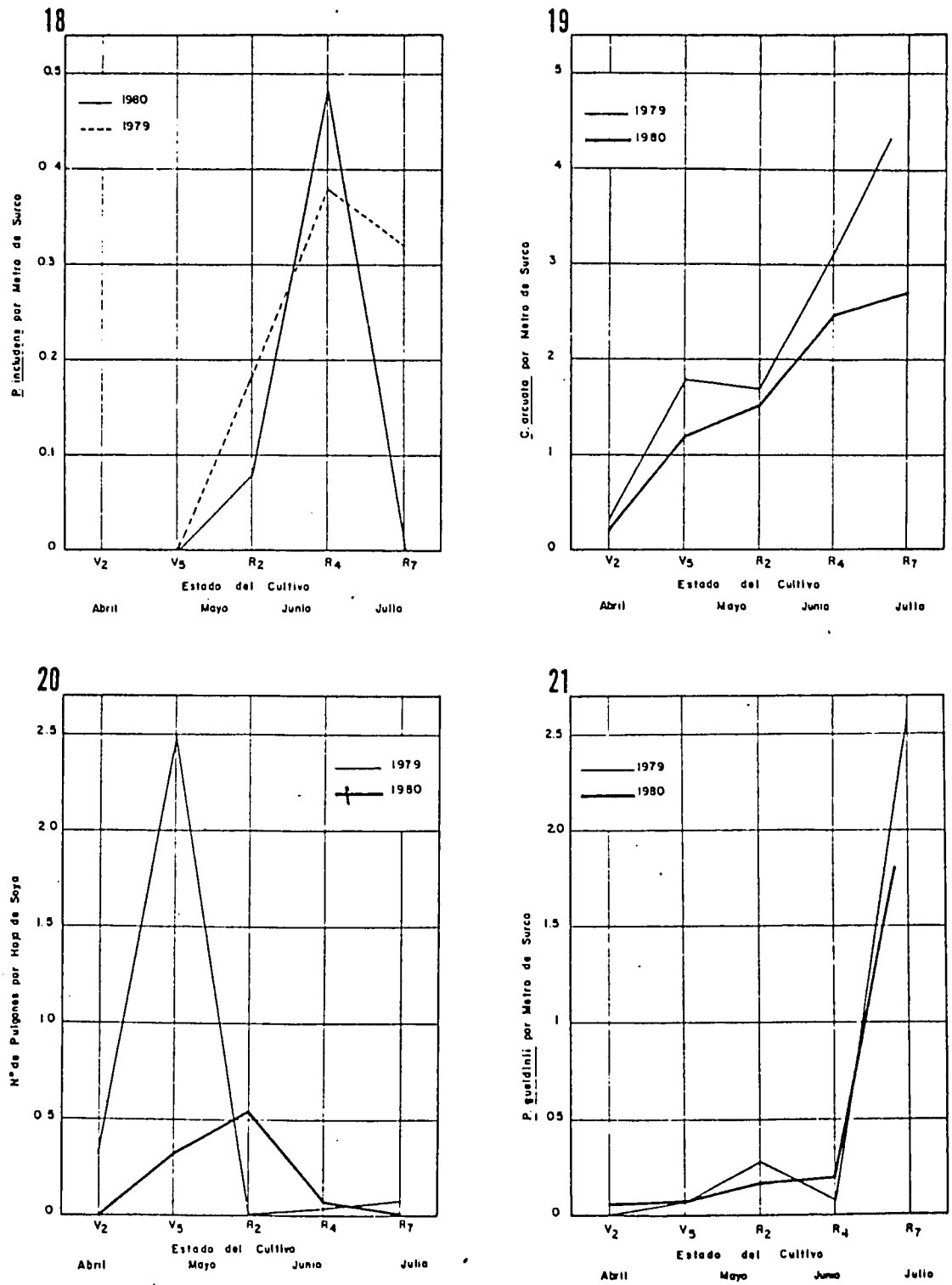








Figs. 14-17. Number of pests per meter of row in soybean plots in Peru. 14. Myochrous sp. adults at Bagua 1979 season with cv. Improved Pelican planted 2 October and harvested 17 January 1980; 1980 season with cv. Jupiter planted 3 October and harvested 23 January 1980. 15-17. Tarapoto, 1980; soybean cv. Improved Pelican; first planting 18 March and harvested 30 May; second planting 23 September and harvested 27 December. 15. Larvae of Anticarsia sp. 16. Adult chrysomellidae. 17. Total Piezodorus guildinii.



Figs. 18-21. Number of pest species on soybean cv. Improved Pelican at Pichanaki (near Satipo), Peru. 1979 season: planted 9 April and harvested 12 July; 1980 season: planted 11 April and harvested 9 July. 18. Larvae of Pseudoplusia includens per meter of row. 19. Adult Cerotoma arcuata per meter of row. 20. Total aphids, Aphis craccivora, per trifoliolate. 21. Piezodorus guildinii per meter of row.

The Coastal site, La Molina. Defoliating lepidopterous larvae were rare in the 1980 growing season at La Molina. They apparently are not currently a major pest complex. Cerotoma fascialis occasionally reaches economic thresholds along the central coast, but this species did not approach this level in the experimental plots (Fig. 22). It is interesting that population densities peaked at about V8, prior to bloom, while those of C. arcuata in the selva alta peaked much later in the season (Fig. 26). C. fascialis is a potential pest along the coast, but it has not graduated to a key pest status.

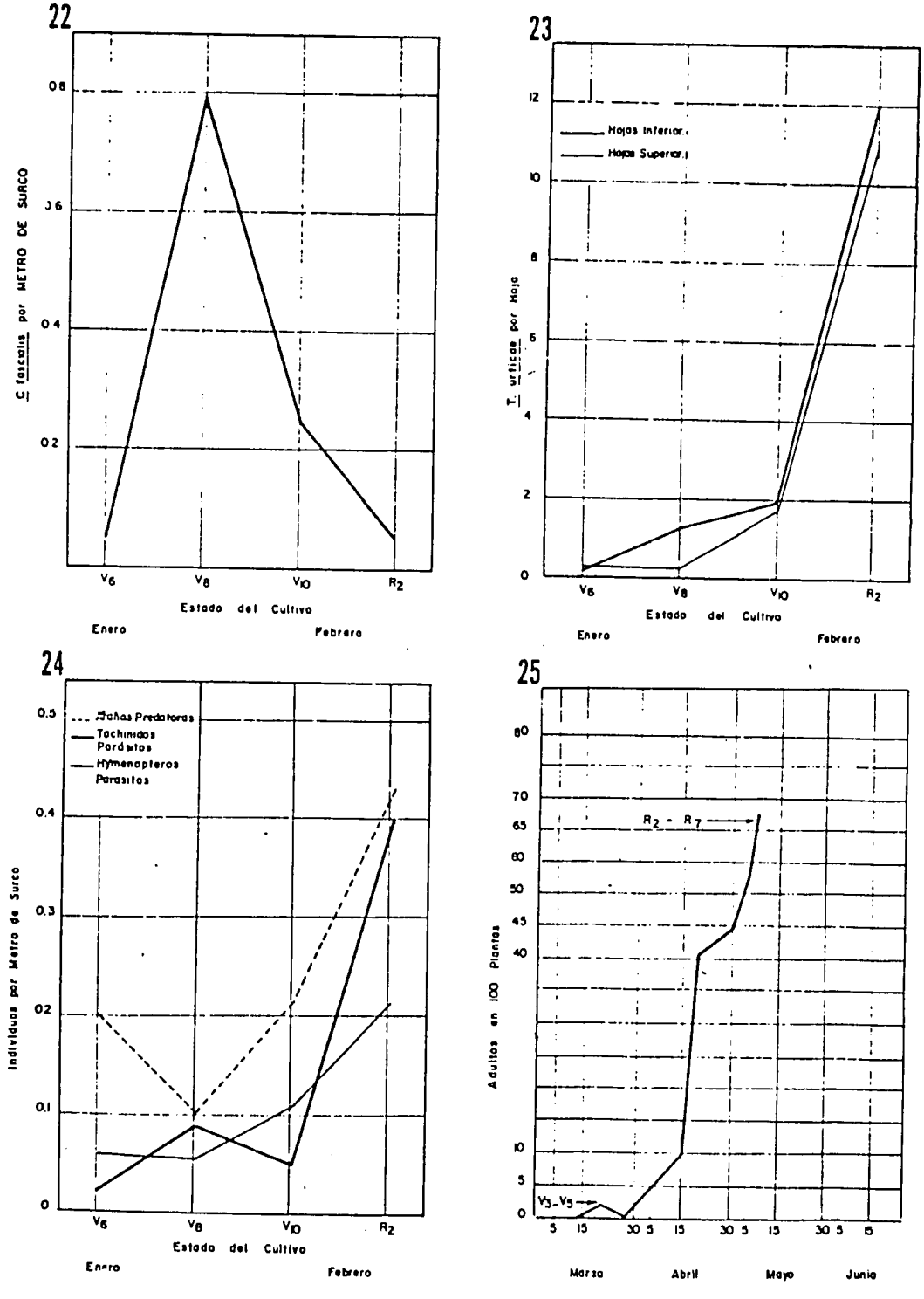
Perhaps the key pest of foliage along the coast are spider mites, Tetranychus urticae, which buildupon upper and lower foliage with equal densities (Fig. 23). Their populations begin to increase during late vegetative growth and they reach rather high populations during mid-bloom (R2-R3) (Fig. 23). The actual damage these arthropods cause and their economic threshold has yet to be determined. Until it is, we must assume that moderately high numbers (e.g.,20 mites per trifoliolate) can cause economic losses.

A complex of shoot, stem, and pod borers is very abundant on the coast, especially near La Molina. This complex consists of Laspeyresia leguminis, Epinotia aporema, and Cryptophlebia sp. Cryptophlebia sp. apparently does not enter pods; L. leguminis appears to be more partial to stems than shoots; E. aporema seems to prefer shoots and buds. The population dynamics of this complex are currently being studied at La Molina, but the data are still being gathered and are not herein presented. It appears, however, that Cryptophlebia sp. is the more common of the complex of species in soybean and bean.

Natural enemy populations were also monitored at La Molina. Spiders were moderately abundant (Fig. 24) but were ten to twenty fold less abundant than in soybean fields at the Bagua site (Fig. 13). Population densities of tachinid and hymenopterous parasitoids were also recorded (Fig. 24).

Consistency of population dynamics at given sites. At both the Bagua and Satipo sites, population densities and timings of key pests relative to plant phenology were consistent in two consecutive years, 1979 and 1980. This was especially true for Pseudoplusia includens, Cerotoma arcuata, and Piezodorus guildinii at both sites. Although this population dynamics study will be repeated at Bagua in 1981, evidence thus far indicates that the current key pests have stabilized reasonably well and similar levels and timings can be expected for many years to come.

Consistency of population dynamics in two different seasons at the same site. It is self-evident that the key and potential pests at the Tarapoto site did not follow the same pattern of population buildup and decline relative to soybean phenology when the crop was planted during two different seasons in the same year, 1980. This study must be repeated, but the data thus far suggest that a different mix of key pests might be present during different seasons. For instance, the major defoliator during the March planting season is likely to be Anticarsia sp., while the major defoliator during the September planting season is likely to be Cerotoma arcuata (Figs. 15, 16). Furthermore, Piezodorus guildinii is



Figs. 22-25. Number of pest and beneficial species on soybean in the coastal areas of Peru. 22-24. La Molina, cv. Nacional planted 30 December 1980. 22. Adult Cerotoma fascialis per meter of row. 23. Adult spider mites, Tetranychus urticae, per upper and lower trifoliolate. 24. Beneficial arthropods per meter of row; predaceous spiders, parasitic Tachinidae, parasitic Hymenoptera. 25. Chiclayo, cv. Improved Pelican, 1979; number of adult ceramybids, Grammopsoides rufipes, observed on 100 randomly selected plants.

definitely a key pest during the September planted crop and may not be during the March crop (Fig. 17). As was stated earlier, this provides a possibility for planting seed increases during the March planting season, something to investigate further.

Consistency of population dynamics of key pests at different sites. From our studies it seems evident that Pseudoplusia includens is a key pest in the Bagua area but not in the Tarapoto or Satipo areas. This may indicate that P. includens prefers a less rainy climate. The timing of peak abundance of P. includens is similar at Bagua and Satipo with almost no specimens encountered at Tarapoto (Fig. 27). While the peak abundance (R3-R4) reaches about five larvae per meter of row in Satipo, it approaches 18 (R2) in Bagua, and that approaches the established economic threshold. P. includens larvae attacked by Neumorea rileyi, a parasitic fungus, reached 50% during growth stage R5 and may have been the key mortality factors that caused the population to crash. In fact, similar levels of parasitism by N. rileyi were reached at growth stage R5 in 1979.

Cerotoma arcuata was more abundant at Satipo than at Tarapoto, and more abundant at Tarapoto than Bagua. Rainfall correlates well with this, suggesting that C. arcuata could be more of a problem where rainfall is heavy. Population densities peak at about the same growth stage (R3-R6) at all sites (Fig. 26), and, from auxiliary information, it is known that C. arcuata is a consistent key pest at the Satipo site but not at the other two.

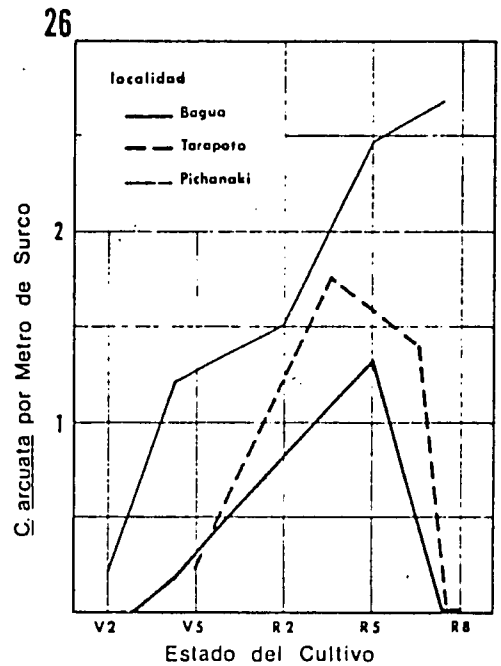
Piezodorus guildinii (Fig. 28) is a key pest of soybeans throughout the selva alta of Peru. Its population density peaks at about the same growth stage in each zone (R5-R7), and, even in our experimental plots, established economic thresholds were surpassed at Bagua and Satipo. Since it is a direct pest, it could be the most important pest of the entire complex. Other species of stink bugs were also important at all sites, especially an unidentified species of Acrosternum.

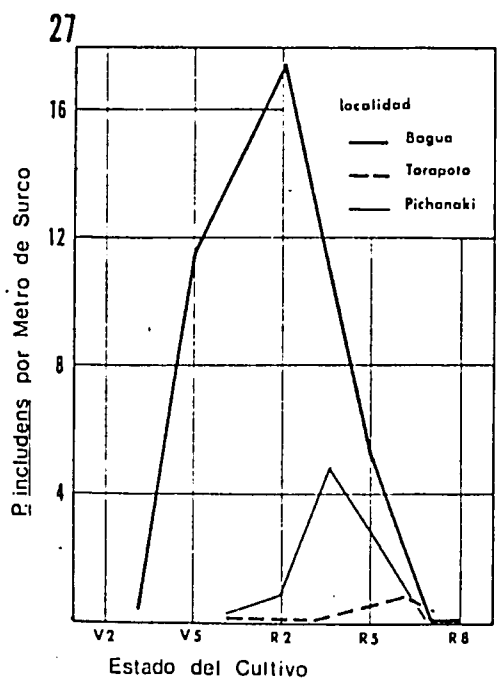
PHASE III: ADJUSTING THE BASIC SOY/IPM PACKAGE

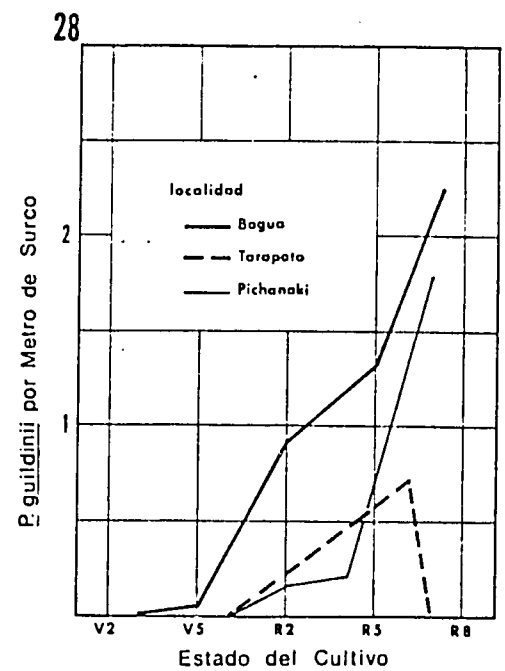
Phase III is an extremely important step in the advancement of the basic SOY/IPM package because it updates and corrects the initial package. It also makes the package more suitable to the particular areas of concentration. At the end of two years we can now approach this phase confidently by using the data accumulated through various experiments and adopting this information in the package. This revision is complete, adjusting the species we initially thought to be pests to our current ideas, adjusting economic thresholds through information recently published and through our own experiments, and revising the pesticide recommendations by incorporating results of our insecticide trials.

New Pests of Soybean

We can confidently include Cryptophlebia sp. as a pest of soybean in both the coastal area and in the Jaén-Bagua area. Although we initially listed it as a pest, the definition was at best tentative. Research currently underway at La Molina suggests it is of pest status; work must now concentrate on its potential to cause yield losses alone and as a member of a complex, and on establishing economic thresholds.







Figs. 26-28. Comparative numbers of key pests at three sites in the selva alta of Peru: Bagua, Tarapoto, and Pichanaki near Satipo during the main 1980 soybean growing season. 26. Adult Cerotoma arcuata per meter of row. 27. Total Piezodorus guildinii per meter of row.

Etiella zinckenella, the lima bean pod borer, has been found in ever increasing numbers in mature and harvested soybean, especially in the Tarapoto area. Because it is a direct pest, feeding on the seed itself, its status as a pest is assured. The population dynamics of this species awaits elucidation.

Grammopsoides rufipes, a cerambycid stem borer, has gained a definite foothold in soybean in the northern coastal area. It was also found in the Jaén-Bagua areas. As a potential new pest of soybean, the biology, population dynamics, and effects on yield were studied at Chiclayo over two years, 1979 and 1980. It was found to form a complex of stem borers with Laspeyresia leguminis in soybean. The numbers of adults increased dramatically through the season, reaching 67 adults observed on 100 randomized plants in a 1 ha. experimental field in 1979 (Fig. 25).

The species has been found throughout the northern coastal area of Peru extending to Bagua but it has not been recovered from the central coast of Peru or from Tarapoto and Satipo. A closely related undescribed species of Grammopsoides occurs abundantly in the southern coastal area of Ecuador, and it considered a pest in that country. The damage the Ecuadorian species causes is visible in the field as dried up trifoliolates or dying plants that are attacked. No such damage is evident from soybean plants attacked by G. rufipes.

One of the aspects investigated was to determine the alternate species of plants attacked by this cerambycid. After a careful and determined search, some 13 additional host plants were discovered, most of them common weeds in soybean fields, common garden flowers, or commonly cultivated crops. The list of hosts follows:

CAPARIDACEAE
- Cleome espinosa Jac.; spiny spider flower

COMPOSITAE
- Ambrosia peruviana; cockelbur, burweed
- Bidens pilosa L.; blackjack, Spanish needles
- Eclepta alba L.; florcita
- Helianthum annum L.; sunflower
- Helichrysum arenarium L.; everlasting
- Lagascea mollis Cav.

LEGUMINACEAE
- Desmodium tortuosum; Florida beggarweed
- Glycine max; soybean

MALVACEAE
- Urocarpidium chilensis

SOLANACEAE
- Datura stramonium L.; jimsonweed
- Nicandria physaloides L.; capulicimaron
- Physalis angulata L.; ground cherry
- Solanum nigram L.; nightshade

The impact of this pest or this pest as a complex with Laspeyresia leguminis was intensively studied. The results, however, are not clear-cut. What information was obtained tends to suggest that soybean plants attacked by one or both species of the complex yielded similarly as those not attacked. A second year's data are available but not yet analyzed. Obviously, a third year's study is needed with the objective of determining if the complex does or does not constitute a pest. If this complex is found not to be of pest status, it can be ignored in the light of our basic SOY/IPM package. One further year's data may hold the answer.

Change in Status of Potential Pest

At the inception of the basic SOY/IPM package, we felt that Nezara viridula would be a key pest in the selva alta of Peru. We now believe that this species does not occur in the region, but two additional genera may be very important: Euschistus and Acrosternum. More work will be done on these genera.

Chemical Control Adjustments

Reports have reached the ears of several researchers that the carbaryl produced and formulated locally (carbaryl-85) does not contain sufficient active ingredient to adequately surpress pest populations at recommended dosages. Since carbaryl is the pesticide we rely on most for controlling pests, we felt it was important to test this formulation against one produced in the USA (carbaryl-80). It was also felt that Dimilin-25, an effective compound on lepidopterous larvae and very safe to humans and natural enemies, should be tested in the selva alta of Peru. A field test of these materials with several others, including a very dangerous compound, monocrotophos, was carried out at a field station in Bagua in 1980.

The results of this field test (Fig. 29) indicate that the carbaryl-85 formulation performed less effectively than did the carbaryl-80 formulation from the USA. Since this study, the Peruvians have begun to formulate carbaryl-80. Dimilin-25, monocrotophos, and carbaryl-80 all performed equally well (Fig. 29). Dimilin is expensive, but the application rate is so low (125g a.i./ha) that it may become competitive. We are now attempting to get Phillips Company to stock Dimilin in Peru.

Adjusting the Basic SOY/IPM Package

From the forgoing information we were able to completely revise and update the basic SOY/IPM package. The population dynamics study allowed us to divide the crop development cycle into three portions: vegetative (V1-R1) (Table 2), reproductive (R2-R6) (Table 3), and maturity (R7-R8) (Table 4). We were able to divide the pests among these growth stage ranges, and with the added information on new and potential pests, chemical control tests, and relevant new literature, we have developed a revised basic SOY/IPM package (Tables 2,3,4).

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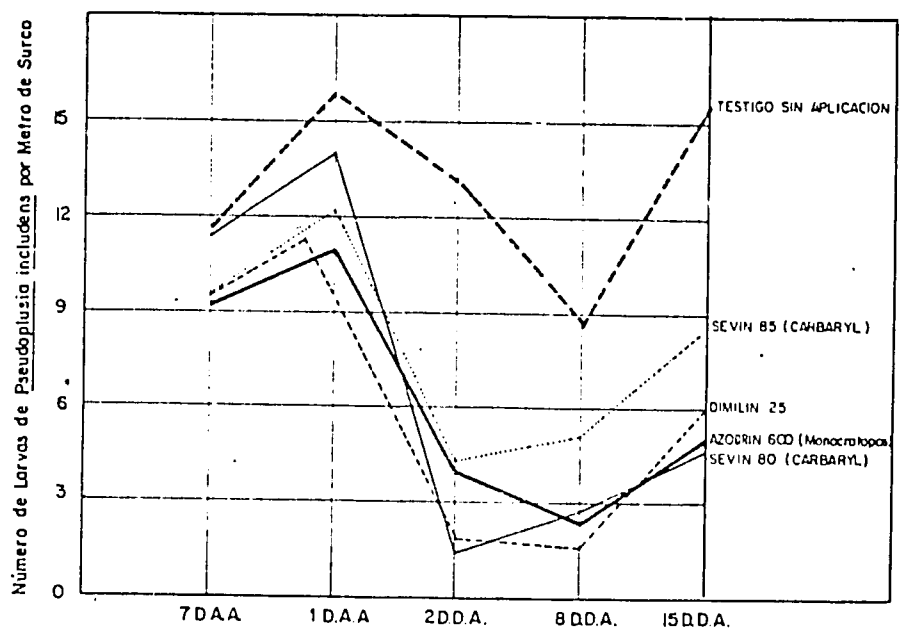

Fig. 29. Numbers of larval soybean loopers, Pseudoplusia includens, per meter of row 7 and 1 days before application (7 D.A.A., 1 D.A.A.) and 2, 8, and 15 days after application of various insecticides. Bagua, Peru, 1980, soybean cv. Jupiter.

Cuadro 2. Plagas actualmente reconocidas en Soya, niveles de daño económico, estado vegetativo y reproductivo de la planta y recomendaciones.

Estados: V1 - R1

Plagas	Indice de Daño Económico			Insecticides y Recomendaciones Gramos/Ha
Nombre científico	Estado	Nº/Metro de surco	Daño	Ingrediente Activo
Spodoptera eridiana Elasmopalpus lignosellus	Larvas de cualquier tamaño		40% plantas atacadas	750 Carbaryl 600 Methyl parathion
Acheta assimilis	Ninfas y Adultos		40% plantas atacadas	750 Carbaryl 480 Monocrotophos
Anticarsia gemmatalis Pseudoplusia includens Spodoptera sunia Spodoptera frugiperda	Larvas mayor de 15 mm	20	25% defoliación	750 Carbaryl 650 Triclorphone 150 Dimilin
Cerotoma fascialis Cerotoma arcuata Diabrotica decolor Diabrotica speciosa Colaspis spp. Myochrous sp.	Adultos	20	25% defoliación	750 Carbaryl 400 Fentoato

Cuadro 3. Plagas actualmente reconocidas en Soya, niveles de daño económico y estado reproductivo de la planta y recomendaciones

Estados: R2 - R6

Plagas	Indice de Daño Económico			Insecticides y Recomendaciones Gramos/Ha
Nombre científico	Estado	NO/Metro de surco	Daño	Ingrediente Activo
Anticarsia gemmatalis Pseudoplusia includens Spodoptera sunia Spodoptera frugiperda	Larva mayor 15 mm	20	15% defoliación	750 Carbaryl 650 Trichorphone 150 Dimilin
Cerotoma fascialis Cerotoma arcuata Diabrotica decolor Diabrotica speciosa Colaspis spp. Myochrous sp.	Adultos	20	15% defoliación	750 Carbaryl 400 Fentoato
Hedylepta indicata	Larvas de cualquier tamaño		50% plantas atacadas	750 Carbaryl 250 Hetamidophos
Epinotia aporema Laspeyresia leguminis Cryptophlebia sp.	Larvas de cualquier tamaño		40% plantas atacadas	750 Carbaryl 1000 Methyl parathion
Acrosternum spp. Piezodorus guildinii Otras especies de Chinches	Adultos y ninfas mayor de 5 mm	2		600 Methyl parathion
Tetranychus urticae Poliphagothrasonemus latus	Cualquier		Inician focos de infestación	420 Dicophol 735 Dicophol

Cuadro 4. Plagas actualmente reconocidas en Soya, niveles de daño económico y estado reproductivo de la planta y recomendaciones.

Estados: R7 - R8

Plagas	Indice de Daño Económico			Insecticides y Recomendaciones Gramos/Ha
Nombre científica	Estado	Nº/Metro de surco	Daño	Ingrediente Activo
Acrosternum spp. Piezodorus guildinii Otras especies	Adultos ninfas mayor de 5 mm	2		600 Methyl parathion 600 Ometoato
Epinotia aporema Laspeyresia leguminis Etiella zinckenella	Larvas de cualquier tamaño		10% vainas atacadas	1700 Carbaryl 1000 Methyl parathion

PHASE IV: ALTERNATIVE TACTICS TO CHEMICAL PESTICIDES

The completion of Phase III sets the stage for an investigation into alternate tactics for lowering population densities of key pests. From the reappraisal of key pest species in Phase III, we have identified four as being particularly important in the selva alta of Peru: Pseudoplusia includens in Bagua, Anticarsia sp. in Tarapoto, Cerotoma arcuata in Satipo, and Piezodorus guildinii in all three areas. Phase IV of the SOY/IPM program will initiate a search for tactics other than chemical pesticides to lower population densities of these key pest species enough to eliminate the use of chemicals to control them. These alternative tactics can be many, but three are most important: host plant resistance, biological control, and cultural control.

To date little has been attempted in the realm of Phase IV. The results of pest incidence at different planting times (the two separate growing seasons) accomplished at Tarapoto suggest a cultural control method for lowering population levels of Piezodorus guildinii (Fig. 17). A separate study was initiated at Tarapoto to look at different planting dates within the same growing season and their effects on the population dynamics of Anticarsia sp. Nothing concrete has yet developed, but this is a definite probe into Phase IV activities of the SOY/IPM program.

Future research within the bounds of the SOY/IPM program should be directed toward Phase IV activities. Each key pest must be analyzed with regard to which of these alternate tactics are likely to prove effective, and research should be initiated in those directions.

CONCLUSIONS

Substantial advancements have been made in the SOY/IPM program over the past two years. The basic SOY/IPM package was created in early 1979 and has undergone a major revision in early 1981. Progress on the research aspects of the program is notable, especially regarding the advancements derived from the population dynamics study. To date there has been a decided lack of activity in the area of technology transfer, in putting to work our basic SOY/IPM package. The immediate future must emphasize the need to establish contact with soybean growers and put into practice the fruits of our labors.

A rather detailed set of recommendations resulting from the SOY/IPM study is included in this report. Future activities should follow the guidelines set down in these recommendations.