Appendices

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APPENDIX I

February 14, 1975

A Research Proposal:
An Integrated Control Program for Kearney Field Station

A Research Proposal:
An Integrated Control Program for Kearney Field Station

Submitted by
The Department of Entomological Sciences
Berkeley

ABSTRACT

An Integrated Pest Management project, including staff, is proposed to be located at the Kearney Field Station, to exploit recent advances in research associated with the current NSF-EPA-USDA Nation-Wide IPM Project. This project, to be developed around a centralized agro-ecosystem modeling and analysis effort located at Berkeley, will include a team of scientists and technologists who will pool their efforts to provide and apply the NSF-EPA-USDA approach to a complex of agricultural crops and. crop insect pests, diseases and weeds occurring in the San Joaquin Valley. The major objective is the development and field-testing of analytical methods for assessing the need for and degree of pest control intervention (biological, chemical or cultural) required to optimize production while simultaneously maximizing socio-economic and ecological benefits in the surrounding area. The proposal, initially for a five-year period, envisages staff resident at Berkeley working closely and continuously with resident and new staff at Kearney in this multidisciplinary venture. An essential feature of this proposal is that it be a single, coherent project under the leadership of one director headquartered at Berkeley, with research supervision provided by an Executive Committee empowered to submit recommendations for budget and personnel shifts as needed in the light of interim performance and shifting goals.

AN INTEGRATED CONTROL PROGRAM AT KEARNEY FIELD STATION

1. INTRODUCTION

Pest control has gone through many changes, not the least of which was the development of synthetic insecticides, fungicides, and herbicides. Introduction of these compounds and of synthetic fertilizers into our agroecosystems has had both beneficial and negative impacts on crop production. Wisely used, these compounds have helped increase the quantity and quality of food, fiber, and livestock, and in addition they have improved the quality of human life. But, most unfortunately, prevailing pesticide usage has contributed to environmental problems, produced contamination, and

caused the aggravation of more pest problems (e.g. resistance, rapid resurgence and secondary pest outbreaks due to natural enemy destruction). This has resulted in spiraling pest control costs, yield reductions and deep public concern over environmental impact. Much of the abuse has come about because of: (1) a lack of analytical methods for assessing real need for pest control, (2) the virtual impossibility of making meaningful assessments of the economic, social and environmental impact of pest damage and of pest control practices, and (3) our inability to devise scientifically based alternative strategies to deal with the complex of pests of crops as a whole. Thus, we have had to rely upon chemical control as the immediate solution to most pest problems and the pollutive nature of the chemicals and their excessive use is of great concern to us. On the other hand there is good reason to believe that they can be used more effectively and at the same time more compatibly and economically while meeting both production and environmental goals. This evolution in chemical control is seen to be all the more critical in the light of, on the one hand, increasing world demand for American agricultural products, and on the other hand, pesticide shortages and the waning of petroleum based energy sources.

[It would seem that] the best way to approach such rational use of pesticides is through the strategy of integrated control.

II. THE INTEGRATED CONTROL RATIONALE

Early attempts to develop ecologically sound pest control strategies (integrated control) were only partially successful because of the narrow orientation toward pest control, and the lack of sophisticated methods for dealing with complex interactions between pest control practices and cropping systems on the whole. It has been obvious for some time that in considering integrated control a very wide variety of factors must be taken into account (e.g., weather, crop variety, pests, fertilizers, irrigation, etc.), as well as the pest control measures themselves. This is basically a problem in ecosystem analysis centering in this case on crop pest control. It is therefore highly significant that integrated control (integrated pest management) is taking a leading role both nationally and internationally, in meeting these problems, and, indeed, in bringing new technology to bear in uniting the necessary scientific disciplines. In the late 1960's the National Science Foundation recognized the potential significance of integrated control programs in this area, and eventually set in train a national prototype research program in 1972 under NSF grant GB-347182, supported by NSF, EPA and USDA, and administered through the University's International Center for Biological Control. Projects under this program have made real headway in establishing the systems analysis approach to understanding and solving agricultural pest problems. Inputs from these programs have already been utilized in the USDA "actions" programs for cotton, apple, citrus, alfalfa and soybean, and to some extent by independent pest control advisors and growers acting on their own.

III. THE PROPOSED KEARNEY STATION PROGRAM.

University of California researchers have made striking advances in integrated control. For example, in the San Joaquin Valley important headway has already been made under the NSF-EPA project (above), and in various other Experiment Station efforts in cotton, grape, alfalfa, walnut, citrus, olive and stone fruits.

It is proposed, therefore, that an Integrated Pest Management effort to exploit these advances be centered on research conducted by University personnel at, or associated with, the Kearney Field Station operation.

The crux of the proposed Kearney Station program would be to develop around a central modeling and systems analysis specialist, a team of scientists and technologists to pool their efforts in problem solving research to expand upon the existing integrated control base. In this connection, the proposed program would involve as main principals, the disciplines of entomology, plant pathology and weed science.

Optimal pest control requires, among other things, a thorough understanding of the biology and ecology of each pest, of weather, soil and cultural conditions, and the consequences of each contemplated action on other parts of the system. Thus, the work of scientists in different disciplines must be closely integrated; the modern use of modeling and systems analysis has afforded the most effective tool we know for doing this. It has served to crystallize and effectively bring together the expertise and data from various disciplines. From this base, analytical pest management decision-making can be developed to help the California farmer make his major pest control decisions with minimum guesswork, thereby limiting his use of chemicals to times of essential need. This in turn will minimize the very expensive and often self-defeating prophylactic use of pesticides.

IV. OBJECTIVE

The program will have as its objective the development and field-testing of analytical methods to assess the need for, and degree of pest control intervention (e.g., biological, cultural or chemical) required to Optimize Production and returns for major San Joaquin Valley crops, while simultaneously maximizing socio-economic and ecological benefits in the surrounding area.

V. ADVANTAGES OF THE PROGRAM

1. The program will thrust the University of California, Division of Agricultural Sciences even more solidly into world and national leadership in scientific pest management (i.e., integrated control).
2. This leadership will in turn result in continuing and probably increased levels of financial support for integrated control research and teaching activities, by commodity groups and national and international funding agencies.
3. The program will bring maximum efficiency into the University pest management research effort, particularly as regards the utilization of resources including the NSF/IPM data and resource base.
4. The program will maximize University visibility in the San Joaquin Valley while simultaneously serving as a highly effective research vehicle and not merely window dressing. As with cotton and alfalfa it can be expected that significant benefits of the program will be quickly implemented.
5. The program will set in train studies, which will eventually result in complete analysis of San Joaquin Valley agro-ecosystems.

VI. ADMINISTRATIVE STRUCTURE AND RESPONSIBILITIES

The proposed effort would be a single project under the auspices of the Vice-President—Agriculture. It is suggested that it have a relatively small Executive Committee approved by appropriate chairmen and including working researchers particularly representing entomology, plant pathology, and weed science, as well as a representative of agricultural extension and the project's coordinator. It is absolutely vital that there be a project coordinator and that he/she be an experienced, practically oriented systems ecologist. The coordinator would be responsible to the Executive Committee for integrating the diverse aspects of the program, keeping the Executive Committee appraised of progress and needs, and developing liaison activities with scientists and technologists not directly funded by the project but whose inputs would be helpful.

Fiscal handling of the funds should ideally rest with one account, as experience has shown that split accounting causes many headaches. This would be according to the Vice-President's designation.

The program is envisioned as a five-year effort as a minimum, with extension contingent upon its progress and promise during the first five years. During the first three years the effort would interface strongly with the existing NSF-EPA-IPM project in the Valley for cotton, alfalfa and pome and stone fruits, and grapes would be brought into top priority. Later, as opportunity is afforded, some of the other crops listed above may be brought into the program.

VII. PROCEDURES

It is proposed to establish around a competent, practically oriented pest control systems ecologist, a team of associated researchers and supporting staff from the areas of entomology, plant pathology and weed science. This team will have as its objective the conduct of research to meet the general objective stated above, and centered heavily at first on grape, cotton, alfalfa and deciduous fruits in the San Joaquin Valley.

It is critical that this research be agro-ecosystem centered, and this, in turn, means that it be centered in a particular area, inasmuch as each major agricultural area has its own crops, growing conditions and problems. A system of technology is not entirely transferable, and this is why such a system should be developed specifically to fit San Joaquin Valley conditions.

The field plots will be located in the San Joaquin Valley, and a substantial amount of the supporting laboratory experimentation and synthesis effort will be conducted there.

A significant portion of the personnel will be stationed at Kearney Field Station and others will spend appropriate portions of their time conducting studies centered in the mission area of the Kearney Station operation.

The systems ecologist program coordinator should be stationed at the Berkeley Campus because of its superior computer facilities and the presence there of a wide diversity of experienced scientists and technologists who have been instrumental in developing integrated pest management programs. However, he/she acting as the coordinating hub of the program at Kearney Station will be very much visible there.

It is proposed that one full time entomologist and one full time plant pathologist be stationed at Kearney Station and assigned to this program, and that an existing staff weed scientist be approached to enter the program and be supported by project funds for assistance, to participate significantly in the research effort. Each participating scientist would be furnished supporting staff and funds to conduct research jointly agreed upon by the project's management. Research during the first two years will be weighted toward insect problems, but biological and ecological groundwork will be laid during this period to bring the other pest areas into full participation in the system analysis effort. Work will be conducted most intensively on insect and mite pests and on diseases and weeds, which are most destructive to the subject crops in the Valley.

VIII. PROPOSED STAFF AND SUPPORT

3 Assistant Research Ecologists
3 Staff Research Associates I
1 Computer Programmer
General Assistance
Supplies and Expenses
Travel
Equipment

APPENDIX II

February 1978

Report of the Advisory Committee for the Development and Implementation of a Statewide Integrated Pest Management Program in California

Committee:
Andrew P. Gutierrez, Chairman, University of California, Berkeley
Howard Ferris, University of California, Riverside
David G. Gilchrist, University of California, Davis
Robert F. Luck, University of California, Riverside
Robert F. Norris, University of California, Davis
Christine Shoemaker, Cornell University
Ivan J. Thomason, University of California Extension, Riverside (Statewide)
Sherman V. Thomson, University of California, Berkeley

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INTRODUCTION

The Colleges of Agriculture and Natural Resources of the University of California at Berkeley, Davis and Riverside are responsible for agricultural research within the State of California. Crop and livestock pests[1] alone have been estimated to cost the California agroeconomy at least one half billion dollars a year; costs which are incurred despite the 90 million pounds of pesticides used annually in this State. These costs are incurred in part because information on the nature of many of the pest problems and their interactions with the crop production practices is incomplete. Environmental costs are not included in the above estimate principally because they are very difficult to accurately assess. In the long term, unattended cumulative environmental costs could far outweigh all other considerations.

Conflicts of opinion exist among the experts as to what to do to control pests. However, it can be documented that in specific instances, excessive applications of pesticides[2] have led to 1) outbreaks of formerly innocuous pests, 2) target pest resurgence, 3) development of resistance to the material, 4) pesticide pollution of our food, air, water and general environment, as well as economic disadvantages for certain segments of our agricultural community. Examples of such happenings are not unique to California, but can be found throughout the world.

It is an imperative challenge for the University of California, Division of Agriculture to develop more nearly optimal pest control strategies, to find the resources to implement them, to support the necessary coordinated multidisciplinary research and to integrate the whole process of developing, implementing and expanding the new technology.

The technology to accomplish these goals can loosely be called Integrated Pest Management (IPM)[3] All factors that impinge upon a crop system must be considered. Thus, an effective project is, in reality, an integrated program in crop production and protection. Development of such a project needs the coordinated effort of scientists from several disciplines including agronomy, entomology, nematology, plant pathology, weed science, mathematics, computer science and many others, simply to examine and analyze the various interacting factors in a crop system. The general analytical methods used to approach such complex problems are called "systems analysis"[4]. The crop production and protection problems that farmers face are very complex, therefore, optimal IPM strategies and solutions need to be developed, The University of California has the scientific and technical resources to begin to solve many of these problems, but because it requires increased

[1] The term pest in this report refers to all organisms (e.g., insects, nematodes, pathogens, weeds etc.) in the crop ecosystem, which cause yield loss.

[2] The term pesticide is used in a general sense to include any chemical used to control a target pest species.

[3] Integrated pest management involves the analysis of the production system as specifically related to pest impact on it, the analysis of the specific biotic, abiotic and cultural factors and their interactions that bear upon that impact, and the combining of all appropriate tactics and strategies to optimize the benefits of pest control in the broad sense.

[4] \Systems analysis (c.f. Dr. Kenneth Watt (U.C. Davis)) encompasses all analytical methods used in the analysis of complex problems (i.e., systems) These methods may be more traditional statistical analysis or modern operations research theory.

research development, new research direction, and additional technological inputs, supplemental funding will be required.

GENERAL POLICY STATEMENT

The University of California is an educational and research institution. However, the much of the organizational structure is dictated by educational needs. Historically, instruction in agriculture and related subjects has been offered by disciplinary departments, e.g., agronomy, genetics, entomology, plant pathology, etc. Research responsibilities also have been traditionally organized around disciplinary departments, even though within a department several disciplines may be represented (e.g., genetics, chemistry, biology). Thus the disciplines of pest and disease control (entomology, plant pathology, nematology and weed science) have remained self-contained entities with internal (departmental) primary focus. In the past, this posed no major problems from an educational standpoint, but occasionally it has led to a distorted view of the relative importance of certain types of pests, more importantly it has not encouraged cooperation in attacking complexes of pest problems.

The problem has, on occasion, been further compounded because most agricultural research has been located mainly on three of the University campuses, i.e., Berkeley, Davis and Riverside, and more recently at the San Joaquin Valley Research and Extension Center, Parlier.

Overall coordination for research and extension in Integrated Pest Management in the University was the responsibility of the Division of Agriculture, and the Director of the Statewide Agricultural Experiment Station. The Cooperative Extension Service had a separate Director and thus could operate relatively independent. Experiment Station resources are allocated to and centrally controlled by an Assistant Director at each of the three campuses, and thus much of the programmatic development was and is controlled at the campus level. Active competition for limited human and fiscal resources takes place between campuses, between departments in the same campus and between discipline areas in the same department.

Recent organization developments in the Division of Agriculture should lead to a greatly improved coordination of needed statewide programs in research and extension. The Vice President for Agriculture is Director of the Experiment Station and of Cooperative Extension. Cooperative Extension is now organized along programmatic lines and has an Assistant Director responsible for Pest and Disease Management programs statewide. While large improvements, both in plan and fact, have occurred in coordination of research and extension, there remain serious impediments to developing and implementing Integrated Pest Management programs statewide. Strong disciplinary research and teaching departments on three autonomous campuses, do not find it easy to merge their talents into the highly coordinated and directed multidisciplinary pest management research activities that are critical to the development and implementation of statewide IPM programs. To meet the challenge of the unique demands for coordinated and cooperative efforts in pest management, a new administrative structure for a proposed IPM program has been designed (see organization chart page for administration and funding). The program must be administered by creative and strong leadership, reciprocally buffered from outside pressures by advisory policy and technical committees.

It is proposed that individual projects be funded on an annually renewable grant basis. Project leaders should report directly to the Technical Committee. As with other extramural or grant programs, the project proposals submitted by individuals would be approved by the respective department chairpersons. This insures that chairpersons will be fully informed and commitment of space and resources needed to complete the proposed research will be secured (see page 27). A review-grant system should permit coordination and direction of the overall IPM thrust, as well as encourage high productivity of individuals participating in the program. Publication of research by the individual investigator participating in the research sub-projects is to be encouraged as a necessary aid in their professional and academic advancement. The pressure of the annual renewal of funding could, perhaps, encourage publication productivity. Obviously the program will need current access in a form usable and available, to those data essential to the implementation and modeling components of the program. Participants accept two equal obligations- 1) publication of their results and 2) sharing needed data with the other levels of organization. Individual researchers should be encouraged to constructively participate in all levels of the program organization. Recognition and credit by the University for participation in cooperative ventures should be encouraged and promoted by the IPM program leadership, Strong leadership of the program is essential, particularly when called upon to reallocate funding of unproductive areas or projects. Funds are expected to be short, thus utilization of money, time and facilities is essential if there is to be a coordinated overall program direction.

Implementation has the highest of priorities and should be initiated immediately, where possible, using those results and techniques currently available for certain crops. It is essential to establish early credibility for the program, not only because of the trust represented by the funding, but to encourage acceptance and help from researchers not directly associated with the project, extension, personnel, farm advisors, pest management specialists and, above all, individual growers. Implementation mechanisms can be refined and detailed as further data are being developed and assembled in the various IPM sub-projects. The implementation procedures developed, hopefully, will be general and adaptable to other potential projects.

The essential multidisciplinary, but closely coordinated, approach of the IPM program should be guaranteed by the funding procedures, by the strong leadership and by the project review process. The success of such a multidisciplinary program requires an alternative to the traditional method of money allocation within the University system. Thus, rather than by formulated division amongst campuses and hence to departments and individuals, funds should be allocated by the Technical committees which examine the merit of each proposal to the overall IPM program direction. The administrative and guidance procedures are a suggested way to satisfy the goal of synthesizing the talents and productivity potential of an evolving coordinated network of individualistic research scientists. Such researchers will be challenged to make a commitment to a philosophy of suppressing disciplinary individual parochialism and contributing their efforts to the understanding of interacting plant-stress complexes that ordinarily are not discernible on disciplinary grounds. Experience suggests that such a resilient, indeed, philosophical commitment is necessary for coordinated progress in such multidisciplinary programs.

THE NATURE OF THE IPM PROBLEM

To determine the most effective control program for a complex of pests, it is useful to view a crop field as an ecosystem of interacting components. The major components of the biotic part of the ecosystem are the crop, its pests, and beneficial, organisms that suppress pest populations or promote plant growth. The dynamics and interactions among these several populations are influenced by the abiotic environment, including solar radiation, temperature, humidity, and the availability of water and nutrients. Moreover, the cultural practices used to grow the crop have various interactions with biotic and abiotic factors.

Figure 1 is a schematic diagram of some crop management practices that either directly or indirectly affect pest populations and the damage they can cause. Pesticides are frequently used to control weeds, plant pathogens and insect pests. Weeds and some nematodes and soil insects, or ones which pass a stage of their life in or on the soil can be directly suppressed by cultivation or deep plowing.

A large number of other crop management practices when applied to other parts of the ecosystem can have an indirect effect on pest damage, e.g., variations in time of planting or harvesting. Changes in plant spacing can have a primary effect on the crop and may indirectly affect a pest by changing the environment. Different kinds of pests may be affected in different ways and degrees. Therefore, in looking at cultural practices, it is important to assess their impact on plant growth as well as on pest damage within the context of the abiotic environment. For example, development of rapidly maturing varieties of cotton have been important in the, developing of integrated control programs in Texas. There the cotton can be harvested before the cotton boll weevil populations reach peak densities. However, the same program using an early maturing type of cotton is not effective further east because of the difference in climate.

Climate is an aspect of the abiotic environment, which is difficult to control. Man can, however, modify microclimates to some extent. Other climate aspects of the abiotic environment, such as soil texture, water supply, humidity under the crop canopy, and nutrient content of the soil and the crops themselves, are routinely managed by such practices as cultivation, irrigation and fertilizer application. Such management practices can affect plant growth and their ability to withstand or tolerate pest damage. They also can influence the micro-environment of the pest and beneficial species populations, their rates of population growth and mortality. For example, irrigation may increase humidity and creates a more favorable climate for some plant pathogens and insect pests as well as beneficial species.

The advisability of using direct methods of pest control, such as pesticides, may also depend upon the dynamics of other parts of the ecosystem. Temperature, which affects the rate at which all of the populations are growing and the synchrony of their phases of development with one another, can influence the effectiveness of a pesticide application or that of beneficial species in preventing yield loss. There also may be an interaction among pest populations. For example, removal of weeds can remove alternate habitats of plant pathogens and their antagonists, as well as sites for insect pests or their predators. Various examples are known. Pesticide treatments for one species can directly or indirectly affect other pest species. For example, insecticides have depleted populations of earthworms that are important in maintaining soil porosity. Soil fumigation may retard crop growth by killing soil microorganisms involved in the nitrogen cycle.

8.

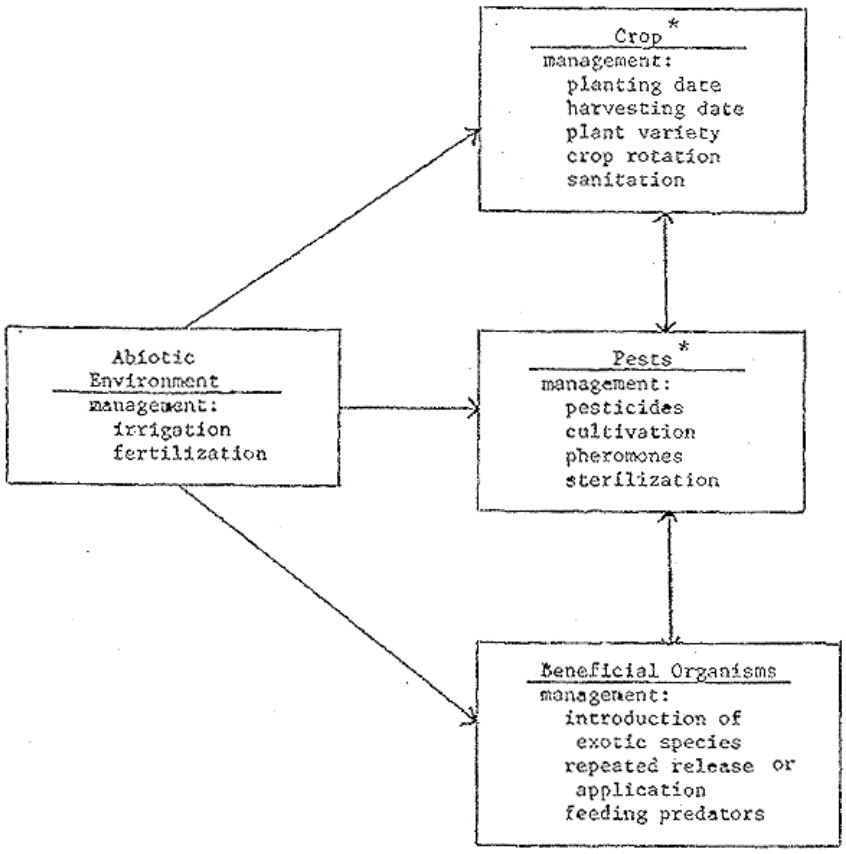

Figure 1. A generalized schematic diagram of a crop ecosystem which shows the relationship amongst the various interacting components and some possible management practices.

* The management practices listed above may apply to the crop and/or specific pests.

Outbreaks of insect pest populations have followed the damaging effect of insecticides on populations of parasites and predators that were active in suppressing pest populations. Insecticide applications can exacerbate weed problems. For example, the application of insecticides for alfalfa weevil control also acts on insects that feed upon weeds in the crop.

Thus, the goal of efficient management of a crop production system is to blend an understanding of the effects of management decisions on biological processes with an analysis of their effects on economic returns. Net return depends upon the size of the harvest, the market price of the crop, and the costs of crop management, i.e.,

net return = price of commodity x yield - costs of crop management practices (1)

The basic object of the pest management program for individual growers is to increase the net economic return. In the long term, optimal sense this is not necessarily equivalent to maximizing yields or minimizing pest densities. Pest control actions are justified economically only when the cost of the action is less than the value of the crop damage prevented. From a societal point of view, environmental and other social costs should be considered. Fortunately, it does not necessarily follow that consideration of environmental and social costs will increase production costs or decrease yields.

Societal costs are difficult to quantify, and hence although their importance is recognized, our discussion addresses the more manageable within-field crop protection problems. Thus, the economic threshold is the population density **P** such that

cost of pest control = price per unit of commodity x yield loss (P) (2)

where

yield loss = expected yield - actual yield as modified by pests.

Equation (2) will establish the conditions for which pest control actions are advisable. Growers using economic thresholds will implement a control practice (usually a pesticide application) only when the density of the pest infestation threatens to exceed an economic threshold. Where used, the number of pesticide treatments required and the cost of pest control can be substantially reduced for some crops. For example, a recent study of cotton insect control estimated that the implementation of scouting programs (pest population monitoring by professional insect scouts) would reduce insect control costs by $26 million on 10.6 million acres of cotton throughout the nation. In California, the Pear Post Management program has resulted in pest control savings estimated to vary from $49.37/acre in Sacramento County to $6.21/acre in Lake County.

It is clear from equation (2) that the economic threshold depends primarily upon the relationship between yield loss and pest density (P). Some efforts to establish this relationship have been based upon empirical studies in which fields were artificially infested with varying densities of pests and the resulting yields measured. An example of this approach is a study that estimated economic thresholds for the Egyptian alfalfa weevil.

As originally defined, the economic threshold depends only on the density of the pest infestation. However, it is evident that the potential for damage depends upon weather, the vigor and maturity of the crop, the time of the pest infestations, the age structure of the pest populations, the size of the beneficial population as well as other factors. Therefore, the economic threshold should depend upon all major factors influencing the advisability of a control action.

It is clear from equation 2 why all of these factors have not been considered in the empirical development of economic thresholds. It is difficult and expensive to obtain statistically significant

estimates of an economic threshold. To establish economic threshold empirical functions of several factors would require an extremely large number of field trials - many more than is economically feasible to make.

It is for this reason that there has developed a considerable interest in using mathematical models. The goal of these models is to aid in understanding the way in which interaction of the many factors such as weather, population densities and age structure effect yield and the success of the various biological, cultural and chemical means of pest control. The models are of no intrinsic interest, they are merely a convenient tool. It is hoped, that by describing mathematically the way in which pairs of components of the ecosystem respond to one another, that insight can be gained about the behavior of the system as a whole. Such insight can then be used to help make decisions regarding the combinations and timing of pest control practices to be used.

Several different types of models are used in pest management. The simplest are the phenology[5] models used to predict the time at which certain events, such as pest emergence, occur. Phenology models can be useful in determining the timing of pesticide applications. More complex models of the dynamics of population growth and development are called simulation models. The models may use detailed information about the physiologies of the organisms under study, their age structure and behavior, and their responses to changing weather, beneficial species and pest control measures. A major value of simulation models is in attempting to examine the interrelationships among populations and the influence of the abiotic environment upon these interrelationships. They can have extremely practical uses in examining the impact of cultural, biological or chemical control practices on the dynamics of the pest population on crop yields. However, to evaluate a large number of pest management alternatives, simulation models are inefficient in terms of computer time and therefore costly. To more inexpensively determine the optimal type and timing from a variety of potential pest control strategies, optimization models are used.

The data used to develop models come from field and laboratory studies. Other data not used in formulating the model must be collected in order to evaluate the model. In this way predictions of the models can be compared to observed data to examine the ability of the model to estimate factors such as time of pest emergence, reproductive potential, effectiveness of pest control methods, and yield. Long-term prediction, under any system, is hazardous. The value of a model is not whether or not it gives an exact answer, but rather whether it results in a gain in understanding, in predictive ability, and a management efficiency that exceeds that obtained, without using a model.

CURRENT STATUS OF IPM

California - The concepts which underlie IPM were originally developed in California under the term "Integrated Control." The University of California has been a world leader in this field, but recent developments in computer-based cooperative IPM research have placed the University in a less than forefront position in this area. The current highly competitive tri-campus structure in agricultural research, as well as the tendency to encourage and reward individual research efforts within the University more readily than cooperative efforts has had its effect on our IPM leaderships role. This is most unfortunate because the University of California possesses the largest and

[5] Phenology models are used to predict, the occurrence of some species specific event (i.e., a phenomenon),but not its population dynamics.

Table 1. A summary of research accomplishment in systems oriented integrated pest management in California.

Crop	Plant model	Pest models	Beneficial species**	Weeds	Current IPM	Prospects for systems oriented IPM[4/]	Optimization models
Cotton	Yes	Pink bollworm* Bollworm Lygus hesperus* Beet armyworm* Cabbage looper* Mites Root knot nematode Verticilium wilt*	Yes	?[5/]	USDA/ES Kern Co. Experiments	Good	Lygus hesperus Pink bollworm
Alfalfa	Yes	Egyptian alfalfa weevil* Blue alfalfa aphid Pea aphid Lygus Spotted alfalfa aphid Phytophora, weeds	Yes	Yes		Good	Egyptian alfalfa weevil
Grape	Soon	Omnivorous leaf roller Grape leafhopper - Anagrus Orange tortrix Root knot nematode	Partial	?		Good	None
Pome	No	Codling moth Fire blight Mites - (MSU & WSU)	No		El Dorado Co. Experiment	Good	None
Citrus	No	Red scale	No			?	None
Tomato	Yes	Root knot nematodes Loopers?	No			?	None

*These models have been coupled with the plant model.

**Beneficial species refers to classical, biological or natural control of insects, mites, weeds or pathogens.

[4/] IPM project which uses more sophisticated methods of analysis.

[5/] Information unknown.

finest reservoir of research talent of any Agricultural Experiment Station in the United States.

Despite these problems California has made considerable progress in IPM in many areas, especially those projects funded under the Huffaker Project (NSF/EPA GB-34718) or those initiated by the Federal Government as companion efforts. Table 1 summarizes much of the current status of the research effort underlying the IPM work on five California crops: cotton, alfalfa, grape, pome fruits, citrus and tomato. It is impossible to catalog all of the information known about each crop; hence the items included in the table are those for which it is believed a reasonably complete model for the various crop-ecosystem species could be developed.

Cotton, alfalfa, grape and to a lesser extent pome and stone fruits have benefited from research emphasis. Implementation trials have been made for cotton (USDA/ES funded Kern, Tulare and King County experiment) and pears (USDA/ES funded California Pear IPM Program). The pear program used phenology models for fire blight and for codling moth. The phenology models help determine when pesticide sprays should be applied. The cotton program did not use a model, rather it stressed the need to determine the relationships of the fruiting stages of the plant and numbers of Lygus bug. The highly indeterminate fruiting and growth form of cotton increases the complexity of the problem, and it is more difficult to develop pest control strategies for cotton than for more determinate fruiting crops with fewer potential pest species. Both programs are judged to be important successes and indicate the future potential for IPM in California.

The relevant entomological data bases for cotton, alfalfa and grape are extensive and surpass those for any other crops; these data are sufficient for initiating preliminary implementation IPM programs (Appendix I for a model research program in cotton). In addition a preliminary model for verticillium wilt in cotton is nearing completion.

Considerable progress has been made in developing data management programs for IPM field and weather data. Computer programs have been written for easy access from remote terminals, and they are currently being studied for possible use on mini-computers that could be placed with farm advisors and IPM consultants.

United States - Several universities in the United States have developed systems-oriented IPM projects. The most extensive ones are those at Michigan State (MSU), North Carolina State and Texas A&M Universities. The MSU effort is perhaps the largest and most intensively developed and it has been extremely well funded. Emphasis has been principally on the cereal leaf beetle in oats, and apple scab, codling moth and mites in apples. Team research has focused on developing a regional on-line information delivery system (i.e., the model is accessed from remote terminals via telephone to the main campus computer). This method involves substantial expenses for the equipment and installation, for computer time, telephone connections and use, and for adequate University monitoring and extension personnel to service the program. Such a system may not be the most suitable for California conditions. The North Carolina computer effort is less sophisticated than that of MSU, but does emphasize the gathering of more extensive regional pest-plant data. The Texas A&M effort stresses the use of mini-computers in extension offices. Mini-computers may be the most promising avenue for California conditions. Most of the 18 universities that have participated in the NSF/EPA-IPM project have not yet developed extensive computer oriented IPM

systems, although many are currently considering them (e.g., Mississippi, Arkansas, Pennsylvania, etc.).

California's research progress in IPM compares quite favorably to any of the other projects, except in the area of implementation results. Here a major stumbling block has been the lack of available funds for the necessary personnel and for information delivery hardware.

International - At meetings of the International Institute for Applied Systems Analysis (IIASA) held at Vienna, Austria and the European Plant Protection Organization held in Paris, France, in November 1976, it was evident that the United States had taken the lead in the development of advanced IPM technology. Only the University of British Columbia (Canada), Imperial College (U.K.), certain institutions in Japan and the Netherlands have a comparable research orientation.

Prospects for the future - Research coordinated with systems analysis is not a panacea for our agricultural problems, but it is probably our best available tool to organize our research efforts and to synthesize our results for solving our complex agricultural problems. This technology, developed in engineering and used with great success in many related industries, and commerce, promises to be of equal use to agriculture

Many IPM research groups nationwide have stressed prediction of pest densities or yields, but since the organisms in the agroecosystem develop in response to weather that cannot be reliably forecast, such predictions of pest damage and/or yields are tenuous. The models used for prediction are simplifications of the system and may have a low level of predictive reliability because of parameter estimation errors, imperfect formulation, or incompleteness. It is unrealistic for anyone to expect to be presented with accurate predictions of pest populations and yields. Rather than prediction a better use of models is to help assess the general interaction of organisms and the crop when modified by weather, cultural practices, pesticides and other factors. The models are justified if they can be used to develop general optimal crop production and crop protection strategies (i.e., what the mature of the problem is and what should be done generally.

It has been suggested that the control of the Egyptian alfalfa weevil be directed against the adults during midwinter rather than using the current practice of controlling larval populations in. early summer. Field work and computer analyses on the economic impact of lygus bug suggests that its pest status in cotton has been grossly exaggerated, and that it is a pest only daring the early fruiting period. More importantly, the work has explained many of the apparent discrepancies in previous research. Work on pink bollworm has elucidated the interaction between the pest and the fruiting patterns of the plant.

While systems analysis is not a panacea, the methodology is extremely useful in the following ways:

1. serve as a focus for coordinating multidisciplinary research.
2. to help evaluate research information and hypotheses about relationships.
3. to help conceptualize and simplify complex problems (e.g., Cotton growth and development).
4. to assess the phenology and population dynamics of the various organisms in the agroecosystem and their interactions with each other and with crop production options.

5. to estimate the economic returns of various crop management alternatives.
6. to help formulate IPM tactics and strategies.
7. to organize and structure information as a compendia (i.e., models) of current knowledge about crop systems, which can be expanded as required.
8. to serve as teaching aids in providing insights and proper procedures for handling current research information by farm advisors, IPM consultants and students.

IMPLEMENTATION OF IPM RESEARCH

The biologies of the major insect pests of cotton, alfalfa and grape are well known. Figure 2 illustrates, from an entomological perspective, the interactions of these crops with their pests. Progress has been made toward understanding and modeling verticillium in cotton and root knot nematodes in some crops (see Table 1). Research areas which must be emphasized in the future (if we are to fully assess the impact of the whole complex of pests on yields) are crop plant photosynthesis, nitrogen flux in the soil, and plant-water relationships. Most certainly, other critical areas will be identified in the near future. Considerable effort is currently under way to complete much of the work listed in Table 1, although it is realized that all aspects of the work may never be completed. The results already in hand promise improvements in our perceptions of pest management problems. The following results and time table for implementation are envisioned: 1) Phenology models for many of the important insect pests of cotton, alfalfa and grape are currently available for crop protection implementation purposes. These models would be most useful in predicting pest generation times and the proper times to institute some control, 2) The FORTRAN programming for plant models (see above) and many of the insect, disease and nematode pests models (see Table 1) is well in hand, but they must be rewritten in BASIC or APL computer language if implementation is to involve mini- computers. The lag time for rewriting process is approximately one year, assuming that a computer programming staff and mini-computer equipment become available. 3) Similar time frames are expected for the conversion and implementation of optimization programs for the Egyptian alfalfa weevil, lygus bug and pink bollworm (see Table 1),

The major problem in implementing a new technology is the educational one. Recipients of the technology must accept and understand its uses and its limitations. The technology not only requires that the biologists (U.C. Cooperative Extension and IPM consultants) look at the growth and population dynamics of the crop, the variety of the pest and their natural enemies from a new perspective, but also that that these same biologists be receptive to the use of the mathematical formulations and computer based formation implementation. Transfer of this technology means that cooperating scientists will need to effectively translate the notions of models to rules of thumb, which can be used in the field. This is a difficult task, as it requires a fairly complete understanding of the management problem before such simplifying can even be considered. Nevertheless, it is necessary. Many of these results are currently available (e.g., the underlying basis for using lygus/cotton square ratios in assessing damage impact). Many other insights can be usefully developed within the next three years.

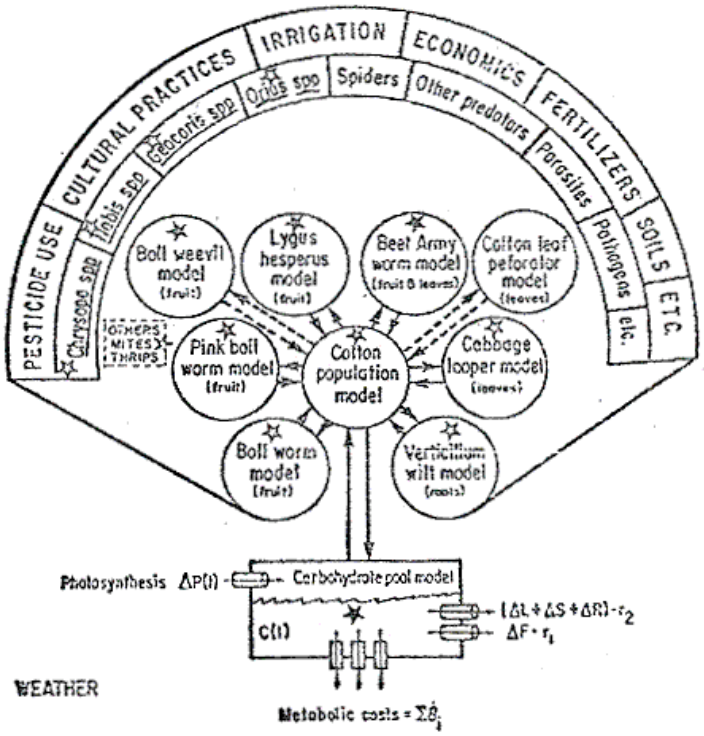

Figure 2. Some of the potential interactions in a cotton ecosystem. Notice that all interactions ultimately impinge on the carbohydrate pool model. The solid stars indicate those models which have been completed, while those with open stars are near completion.

ORGANIZATION AND FUNDING STRUCTURE

(a) Administrative Structure (see Fig. 3).

The administration of the program will be the function of an executive committee with the advice of a policy committee and a technical committee. The executive committee, at a minimum, consists of the project director and two associate directors (chairman of the policy and technical committees), and is responsible for reporting the recommendations of the technical and policy committees to the Vice President. To facilitate communication between committees, the project director will be an ex officio member of both the policy and technical committees. The executive committee is expected to forward to the Vice President the obligatory majority reports issued by the policy and technical

committees, but it may also submit minority reports. Final approval of the expenditure of monies rests with the director and the executive committee.

The policy committee should have the responsibility of representing the program to administrators within the three campuses of the Agricultural Experiment Station and of incorporating aspects if their suggestions, as appropriate, into the program's policy framework. Through these channels, it is expected that the policy committee can provide the program with a critical evaluation of general policy and can remain sensitive to the support and needs among the relevant disciplines and administrators. To increase fiscal support, the policy committee may wish to solicit supplemental funding from non-state agencies such as NSF, EPA, USDA and grower organizations.

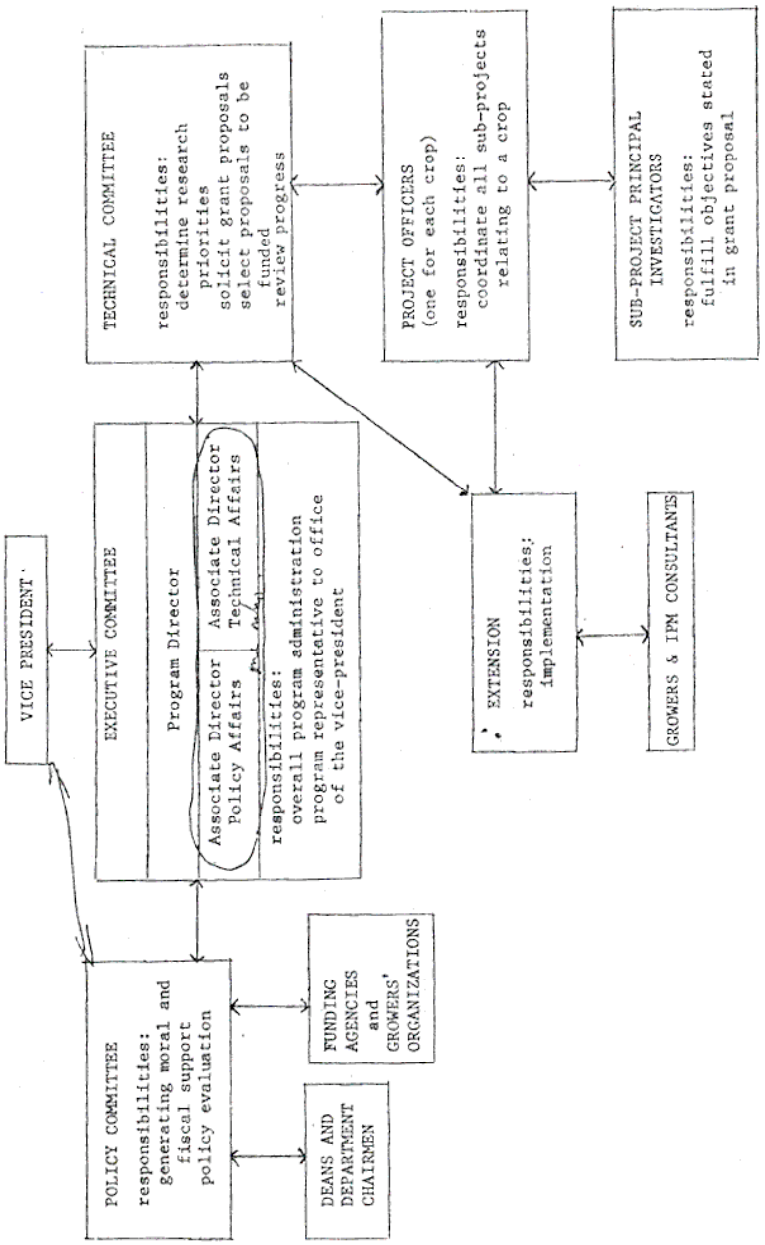

Figure 5. A proposed administrative structure for the Statewide Integrated Pest Management Program.

The technical committee is responsible for developing research priorities and for deciding which proposed projects and subprojects should be funded. This committee will develop a detailed outline of the areas of research that need to be completed and will solicit formal grant proposals to meet these needs from University staff. Decisions affecting the initiation of grants will be made on a competitive basis and renewal will be determined annually. Renewal of grants will be based upon the technical committee's judgment of the sub-project's progress in achieving the objectives stated in the original grant proposal. A crop project officer will be recommended by the technical committee which is to coordinate all the sub-projects relating to each crop. The technical committee, especially its chairman, will maintain frequent contact with the several crop project officers and sub-project principal investigators. The technical committee will determine the long range evolution of the analysis by engineers and programmers employed to service the project. This direction will include: determination of the problem to be investigated, the end products expected and allocation of time. One member of the technical committee should serve as liaison for all technical personnel employed by the program e.g., a modeler. Members of the technical committee should be people who are themselves currently involved in interdisciplinary pest management research, and represent several disciplines including agronomy, entomology, nematology, plant pathology, weed science, cooperative extension and one with experience in the modeling phases of integrated pest management. It is suggested that the technical committee should not have more than nine members including the ex-officio program director.

PRIORITIES, FUNDING AND EVALUATION

1. Determination of research needs:

Identification of general and specific target crops and the research needs of the overall project, and of the individual crops chosen will be the responsibility of the technical committee, working in collaboration with the director and individual project area coordinators.

a. The definition of general data needs for each crop specific agro-ecosystem (i.e., project) will be the responsibility of the technical committee. Inherent in this charge is recognition that wide differences in the available data exist in each project area. This fact necessitates a project by project description of the specific data required, an estimate of the time needed for collection of the data, and an assessment of the projected cost of each acquisition. Explicit procedures should be developed by the technical committee for annual review of project progress, re-evaluation and re-statement of project needs, recommending the reallocation of funds consistent with the needs of the evolving data bases required for each project area. The technical committee should determine where specific interactions among and within the crop-specific projects should be, as well as the cross-project needs in terms of personnel, types of technical assistance, program model development and verification, and system-wide equipment (including computer hardware).

b. The project-area coordinators are responsible for determining the specific data deficiencies within each crop project. They should assist the technical committee in establishing priorities in data acquisition and collaborate with the technical committee in the preparation of notification of contract research needs. Contract grants to individual researchers or small groups of

researchers should be monitored by the project area coordinators, including the specific method of annual reporting of research data to the technical committee.

2. Policy for use of research funds

It is imperative that the block funds allocated to the project for research be awarded to grantees solely on the scientific merit of the individual proposals in relationship to overall program goals. The campus of origin has no relevance. Co-equal or formula distribution of funds to campuses not only would be counterproductive, but probably would be fatal to the program.

Equally important, the technical committee must remain committed to the goal of allocation of funds to benefit the producers and society, not committed to satisfying the career goals of individual scientists, even though it is recognized that the private and societal goals are not mutually exclusive. The annual review process by the technical committee and the project area coordinators are intended to make the program sensitive to the needs of truly cooperative research, to minimize low quality performance, and to encourage continuous self-evaluation within each sub-project.

Guidelines need to be established for such allocation of available funds as to ensure the earliest possible implementation of the research results on crop projects where sufficient data exists or can be readily acquired. Progress and success will determine whether or not other projects on secondary crops can be funded sufficiently to permit their systematic development within a statewide IPM effort.

a. It is suggested that initially a major commitment preferably be made to one, but certainly to no more than three, primary target crop project(s). The selection of the primary target project(s) will be based on funding, on the probability of achieving wide scale implementation quickly and consideration of the economic value of the commodity in California (e.g., cotton, alfalfa, and grapes).

b. Cross-project funding will be recommended by the technical committee and will be associated with the following program-wide commitments:

(1) The analysis group is to be composed of crop-pest oriented individuals with expertise in one or more of the following: biology, mathematics, engineering, economics, and biophysics. As indicated in the policy statement (see page 3), if individuals with such expertise are not found in our active university ranks, it will necessitate system-wide appointments in these critical areas.

(2) Programming staff: programmers for computer software development, plus an engineer for hardware application problems.

(3) Implementation specialists will be responsible for coordinating the implementation of research results in the field via the U. C. Extension service and their cooperating private IPM consultants.

c. Administrative funding will be determined by the executive committee and should include provision for the salary of a small secretarial staff.

d. Allocation of research funds to individual investigators will require the signed approval of and commitment by the investigators' departmental chairperson that sufficient space, other facilities and resources not to be supplied by the project will be provided. Acceptance of project funds will Constitute a moral commitment to perform the outlined research with no discretionary diversion of the funds to peripheral research or that clearly of outside project goals.

3. Research and implementation obligation

a. Many of the research and implementation needs of the project can be satisfied by using the talents of existing Agricultural Experiment Station Cooperative Extension staff. Needed individuals will be encouraged to apply for project grants and, as well, to seek extramural funds to augment the available project funds in order to expedite progress.

b. The time frames for research and implementation proposals should be specified in the grant proposals (Appendix II and III). Failure to meet these commitments may necessitate the reallocation of the funds by the project area coordinators and the technical committee.

c. In submitting grant proposals all investigators should understand that:
They are participants in a team effort. Individual research efforts are defined principally by the needs of the overall project. The success of a multidisciplinary undertaking is predicted on a spirit of cooperation, goal orientation, and shared accomplishment. The project activities will be consistent with the goals and review process of the statewide Agricultural Experiment Station.

d. Agreements with individual researchers will be monitored by the project area coordinators and the specific nature of the research reporting will be determined by consultation with the project area coordinators and the individual investigator(s).

e. All cooperating investigators and their university departmental administrators must:

(1) submit annual reports to be used to progress toward specified research goals, prospects for future progress and allocation of funds(see Appendix IV for review form).

(2) provide access to the relevant data to cooperators in the project.

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Stern, V. M., R. F. Smith, R. van den Bosch and K. S. Hagen. 1959. The integrated control concept. Hilgardia 29(2): 81-101.

APPENDIX I

A Research Program for Cotton - Cotton has been chosen as the model program simply because it has the most comprehensive existing database and the problems have already been well formulated. Figure A1 shows the potential dynamics of this system, while Table A1 shows the project time schedule to complete the-research on the cotton project once it is funded. Considerable work remains to be accomplished, but it is expected that the time schedule can be met provided adequate funds are made available.

Figure A2 shows the interaction by disciplines between the various workers. Workers are encouraged to cross disciplinary lines as their skills allow.

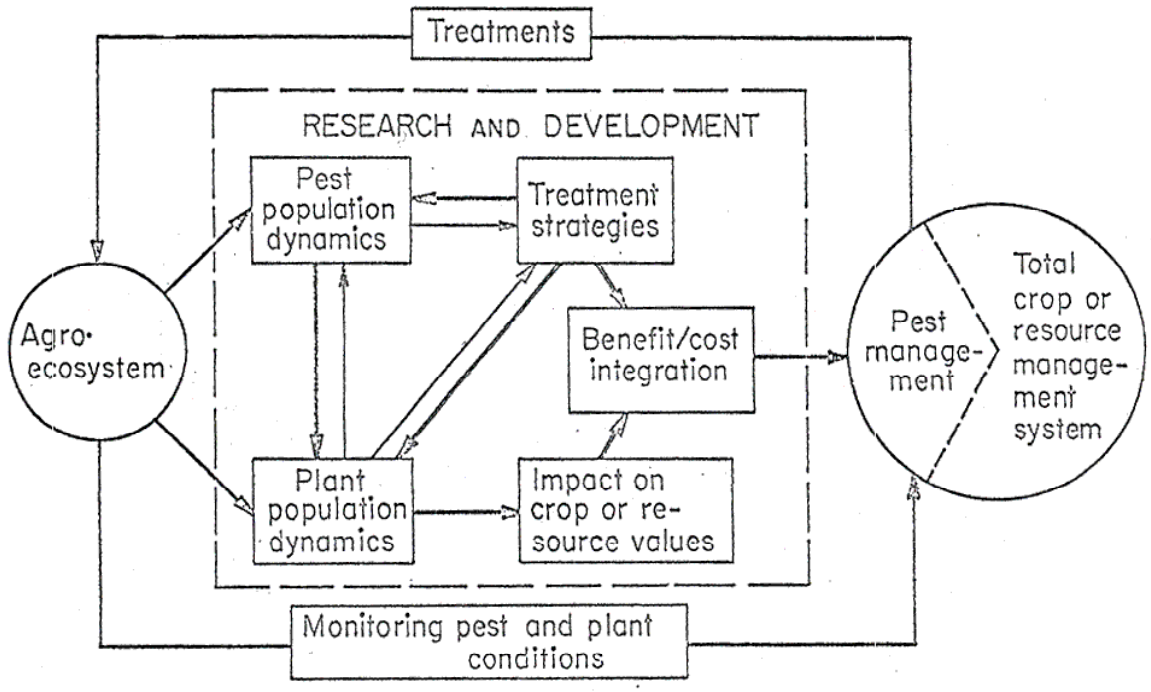


Figure A1. A systems diagram for the flow of research, development and implementation efforts.

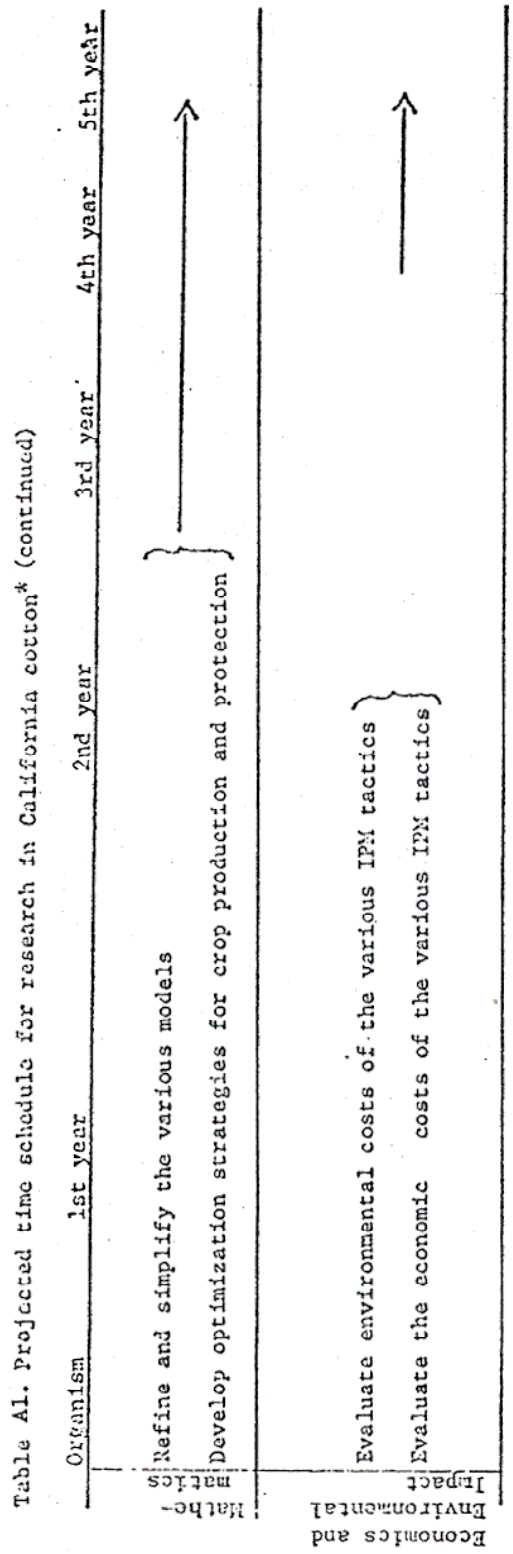
Table A1. Projected time schedule for research in California cotton*

	Organism	1st year	2nd year	3rd year	4th year	5th year
Plant Physiology	Cotton	Phenology and Population model	→	Evaluate results	→	→
		Write code for field implementation	→	Field implementation (Burton)	→	→
		Examine plant-water relationships*	→	Develop models	→	Implementat
		Summarize relevant varietal growth data*	→	Incorporate into management models	→	Implementat
		Studies on factors affecting photosynthetic rates in cotton* (Loomis, Silk)				
Entomology	*Lygus hesperus* regional considerations	Phenology and population models →	Couple Lygus movement in alfalfa, cotton and safflower	Implement	→	→
		Write computer code for field implementation →	Implementation	Evaluate	→	→
		Develop optimization results summaries →	Implementation	Evaluate	→	→
	Cabbage looper and Beet armyworm	Phenology model				
		Write computer code for field implementation*	Implementation	Evaluate	→	→
	Pink bollworm	Phenology and population models	Implementation	Evaluate	→	→
		Write code for field implementation				
		Develop optimization results summaries	Implementation	Evaluate	→	→

Table A1. Projected time schedule for research in California cotton* (continued)

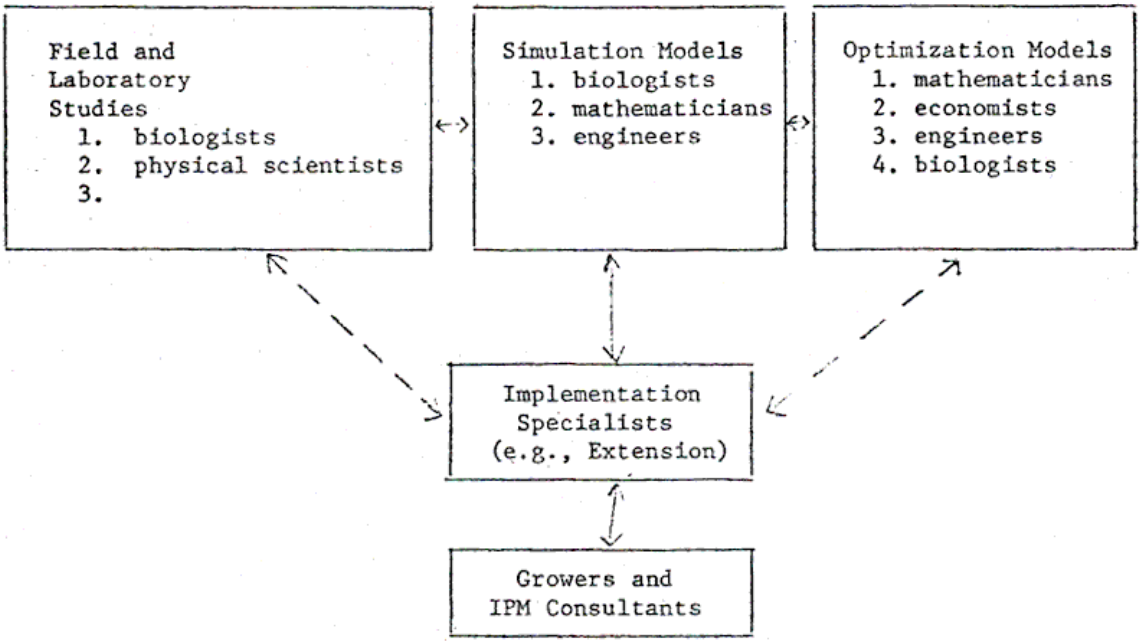
	Organism	1st year	2nd year	3rd year	4th year	5th ye
Entomology	Spider mites	Develop phenology and population models*	Write code for field implementation	Implementation	Evaluate	———
	Natural enemies	Continue development	of these Models* ———	Implement Result ———		Evaluate
Nematology	Examine the impact of root knot nematodes on cotton*		Fund as required ———			
	Cooperator currently unavailable, and is currently being sought.					
Plant Pathology	Verticillium wilt	Develop phenology and population models*	Write code for field implementation	Implementation ——→		
		Field studies	Evaluate other pest problems and determine need	Fund if required ——→		
Weed Science	(Unassigned) Evaluate the impact of weeds on cotton yields Herbicide pollution *	Fund as required ——→				
Computer Science	Finish code for existing data management system	Implementation ——→				
	Finish code for interfacine Weather and Field	Implement and continue development ttof software ——→				

Table A1. Projected time schedule for research in California cotton* (continued)



* Indicates that detailed field studies may be required

Figure A2. The proposed interaction between workers in various disciplines.



APPENDIX II

California Agriculture Experiment Station

Integrated Pest Management Special Grants

Funds are available in the following investigative categories and will be awarded on a contract basis to individual scientists or groups of scientists in the California AES for investigation of the specific problems described, consistent with the goals and needs of the individual programs (crops). U. C. scientists outside of the AES may also submit grant proposals and highly relevant personnel will be encouraged to do so.

Research Categories (*Hypothetical example*)

Outline of crop or area heading followed by specific information needs.

1. Cotton Research: Specific area of inquiry are listed below, but more detailed descriptions of the research are available and should be consulted by interested parties.

Preliminary descriptions of the necessary work would be given here and a reference given to a detailed project discussion written by the Technical Review Commission.

Evaluation and administration

Research proposals submitted in response to this notice will be evaluated by the Technical Committee in accordance with the provisions set down in the system wide Integrated Pest Management program. Monies awarded for project research (crop specific) will be administered through the respective program coordinators. Monies awarded for cross-crop studies, including simulation and optimization model will be administered directly by the Technical Committee. The respective funds will be awarded and available for fiscal year (some specified date).

APPENDIX III

Application Procedures

I. Research proposal submission
   A. Research proposals, corresponding to those in the primary categories, must be received prior to a specified date.
   B. Proposals will be considered for funding only if they conform to the subject-category guidelines as detailed in the Special Grants Notification and as determined by the Technical Committee and Project Area Committee.
   C. Evaluation of all proposals will be by the Technical Committee without consideration to the originating campus or institution.
   D. All proposals must be signed by the investigating research leader, and department chairperson. These signatures will be regarded by Technical Committee as indication of the commitment (including space and resources) to pursue the research activities described in the proposal if funded.
   E. Submit copies of each proposal to: (some specified address)
   F. After grants are awarded, all copies of proposals not funded will be returned to the author.

II. Format for research proposal
   A. Title page
      1. Clear, concise, specific designation of the subject matter, i.e. abstract.
      2. Principal investigator(s) - supply vital % time they'll put in. State his background + experience.
      3. Category or specific research area of proposal.
      4. Date.
      5. Approval signatures.
   B. Objectives.--A clear, complete but concise, and logically arranged statement of the specific aims of the research.
   C. Literature review.--A short summary of pertinent publications with emphasis on the relationship to the proposed research.

D. Procedures.--Description of methodology including such items as: experimental design, sampling procedures, and analyses to be used in attaining the stated objectives. Procedures description should follow some order as objectives.
E. Justification.--Relevancy of proposed research as defined by the stated objectives to the specific funding category to which the proposal is to be assigned.
F. Dissemination of Information.--Discussion of which aspects of the study will be published by the participants at the sub-project level and how the information will be transmitted to other researchers in the program.
G. Research time table.--Show all objectives as function of time. Indicate form and frequency which data will be available to the project computer simulation modeling team.
H. Personnel support.--Inc. job functions.
I. Budget.--NSF format, deleting overhead costs, additional SRA.

APPENDIX IV

Suggested Technical Review Committee Scoring Form

Project Identification Number:_____
Project Title:
A. Relevance of proposal to specific project objectives.(check one)
(1)_____Within guidelines (continue review)
(2)_____Some minor deviations(s) from guidelines
(continue review with notation)
(3)_____Does not conform to guidelines
(return proposal to principal investigator)

B. Scientific Criteria:

	Score* 1-10 Low to High	Comments
(4) Overall scientific and technological quality of proposal		
(5) Research competency of the principal investigator(s), research team, and support personnel		
(6) Adequacy of facilities, equipment, and related program support		
(7) Justification of support requested in relation to objectives and procedures		
(8) Feasibility of attaining objectives during life of proposed research		
(9) Adequacy of proposed mechanism for information transfer to Operations Research		

Unit		
(10) Awareness of published literature and current research related to proposed research		
(11) Relevance and importance of proposed research to solution of specific areas of inquiry identified in guidelines		

Total Score:_____

D. Extended comments: (Use back of page)

*A score of 0 indicates that proposal does not contain information on which to base an evaluation and negotiation with the principal investigator may be indicated.

APPENDIX III

April 9, 1979

Integrated Pest Management (IPM)
A Proposal
To Reduce Pest Damage During Food Production

Integrated Pest Management (IPM)

A Proposal
To Reduce Pest Damage During Food Production

University of California
Division of Agricultural Sciences

~~March 9, 1979~~
April 9, 1979

SCOPE OF THE AGRICULTURAL PEST PROBLEM IN CALIFORNIA

Agriculture is a major productive activity in California, yielding 20 percent of the nation's food and fiber goods. Total cash receipts at the "farm gate" from California's agriculture ranks first among all states with a value of more than $10 billion in 1978. Of the top 25 major commodities grown in the United States, California ranks first in production of seven of them. California's agriculture is the most complex and diverse of any in the United States because its 250 commercial commodities are produced under an extraordinary variety of soils, climates, and environments. In addition to its commercial agriculture California has large publicly owned areas of timber, range and wildlands. Major pest management problems also confront residents in urban areas.

Pests such as insects, weeds, nematodes, parasites, and diseases continually attack food, forage, animals, fiber plants, and trees. Their collective effect is to limit the productivity and value of agricultural crops and forests. In California, approximately 10-20 percent of the production costs of food and fiber is associated with pest management every year. In addition to the direct costs, losses in yield and quality further reduce net returns to the grower and increase costs to the consumer. The current outlay for control by pesticides alone amounts to over 200 million dollars annually. Losses and costs vary among crops and areas, of course, but pests clearly have a significant impact overall on the economy of the State.

It is recognized that some pesticides have adverse effects on the environment and pose hazards to human health. It is equally important to recognize that some pesticides can be used safely.

An approach to reducing the use of pesticides and concomitant costs lies in integrated pest management. This proposal describes a program that combines the efforts of research, extension, and teaching to accomplish integrated pest management in California.

OBJECTIVES OF THIS PROJECT

1. To increase the predictability and thereby the effectiveness of pest control techniques.
2. To develop pest control programs that are economically, environmentally, and socially acceptable.
3. To marshal agencies and disciplines into integrated pest management programs.
4. To increase the utilization of natural pest controls.
5. To prolong the useful life of acceptable pesticides by minimizing development of pest resistance.
6. To reduce the pesticide load in the environment.

UC RESEARCH INTO PLANT AND ANIMAL PROTECTION

The pest management program of the University of California is a broad-based program with significant resources in pest management disciplines on three campuses and nine field stations. The present resources in the plant and animal protection program amount to an annual expenditure of about $19 million, which includes all salaries and support service across a wide range of faculty disciplines. Some 37 percent of funds go into basic research and 63 percent is split about evenly among biocontrol (18%), chemical control (19%), cultural control (13%), and genetic control research (13%). These resources provide the fundamental knowledge, which serves as a database for IPM systems. Recent advances in concepts, data handling, and technology make IPM possible.

At the present time preliminary IPM programs are being implemented on almonds, apples, cotton and pears and to a limited extent on such crops as alfalfa, citrus, grapes, walnuts, tomatoes and lettuce. These preliminary attempts at IPM have shown promise in reducing costs of pest control and reducing unfavorable impacts on the environment. However, further development is limited because of lack in (1) personnel to analyze present data accumulations and to determine data gaps; (2) mathematical systems in which the data can be integrated; (3) personnel to monitor field populations and to collect data quickly; (4) sophisticated methods of data handling for fast information delivery.

Present efforts in IPM have been attained through reallocation of resources. Continual reallocation will impair the ability to provide fundamental knowledge required for a sustained IPM program. Integrated pest management also requires real time data on weather, soil moisture, pest population numbers, predator numbers, and plant growth rates. For these reasons the present research program has to be continued as well as expanded into new areas of data collection and processing. In essence this approach utilizes our long experience in plant and animal protection.

There are six basic components in an IPM system: (1) the abiotic environment (water, heat and light) which drives the whole set of components; (2) population dynamics of the pest (s); (3) population dynamics of biocontrol organisms; (4) growth characteristics of plants and animals; (5) the economic threshold of the pest-caused damage, and (6) treatment strategies. Each of these parts

is a complex subsystem in itself; each requires detailed analysis and understanding. In operation, IPM requires large quantities of detailed and accurate data from repeated field monitoring in all six components. Only computerized data management can reduce, store, retrieve, and perform the necessary calculations to make these relationships useful to those who have to predict the need for and to supervise treatment strategies.

DEFINITION OF IPM

Integrated Pest Management is defined as the use of multiple tactics in a compatible manner to maintain pest populations at levels below those causing economic injury while providing protection against hazards to humans, domestic animals, plants, and the environment.

Integrated means that a broad interdisciplinary approach is taken using scientific principles of plant and animal protection to fuse into a single system a variety of management strategies and tactics. This integration of techniques must be compatible with the total plant and animal production and marketing systems.

Pests include all biotic agents (i.e., insects, mites, nematodes, weeds, bacteria, fungi, viruses, parasitic seed plants, and vertebrates), which adversely affect plant and animal production.

Management is the decision making process to control pest populations in a planned, systematic way by keeping their numbers of damage below economically acceptable levels.

Tactics include chemical, biological, cultural, physical, genetic, and regulatory procedures.

The goal of integrated pest management is to optimize pest control in relation to the total plant and animal production system in the light of overall economic, social, and environmental conditions.

PROCEDURES

The proposed statewide IPM project is designed to be a multidisciplinary program utilizing the resources of three campuses of the University (Berkeley, Davis, Riverside), the San Joaquin Valley Research and Extension Center, the participation of Cooperative Extension Specialists at the above locations and Farm Advisors in the 54 county offices of Cooperative Extension.

Leadership for the program is on board and is the responsibility of the Director, Associate Directors, and an Assistant Director of the Agricultural Experiment Station. Existing research staff will be the principal investigators for most projects.

The project will be organized as follows:

1. Core staff:
   In order to rapidly assimilate, organize and analyze presently available information from diverse disciplines relative to pest management on several selected crops it will be necessary to have a core staff associated with the IPM project. This requires several special task groups for each crop. One is the analysis team made up of four biologists, one mathematician, one biophysicist, and an economist. A second is a programming staff of four to develop computer programs both

for the research and implementation stages of the IPM project. This group should also include a specialist in developing and maintaining a computer assisted communications network.

2. The Computer Programming Staff:
   Programming is needed for two kinds of operations. One is for the research projects and the other for field application. Four persons are required as follows:

   A Computer and Communications Engineer to provide managerial leadership in installation and continued operation of the computer network.

   Two programmers to assist the core staff and research teams in planning data collection and models that satisfy the IPM program objectives. These people will be located with the core analysis team.

   One programmer to assist with local problems in the counties.

3. The grants program:
   The statewide project will be highly goal-oriented. An IPM program for cotton and separately for other crops such as alfalfa, apples, citrus, grapes and tomatoes will be initiated. Data gaps will be identified and research contracted. Each individual research project will be designed to fill a special need and terminated when that need is adequately satisfied. The largest single portion of the project funds will be used to fund these research projects (labeled in the budget as the grants program). Allocation of funding for the grant proposals will be the responsibility of the Director with the advice of the Project Technical Committee, which will examine each project in detail.

   It is anticipated that approximately 30 projects will be funded each year averaging $35,000 each (range $5,000 - $100,000). The rapidly escalating costs of support staff, equipment, travel and per diem make laboratory and field-oriented research costly activities. IPM programs require large amounts of laboratory and field data on the biology, physiology and ecology of pests and host plants.

   It further requires field verification of models of various pest phenologies or host/pest interactions. These activities are expensive in terms of time, travel and human resources as well as in terms of computer technology. Thus, an average funding of $35,000/ research project is modest.

4. The Computer Network:
   Purchase, installation and utilization of a computer-assisted communications system for processing and disseminating IPM information is absolutely essential. Complex, multidisciplinary IPM programs on crop systems require storage, retrieval and analysis of large volumes of biological and weather data. Furthermore, pest management actions must be timely to be effective. Rapid turn-around time on pest management inputs and the dissemination of action information is best achieved through a computer-assisted network. In a large diverse state—both climatically and in terms of cropping patterns—like California, it is especially important to have such a system. It is anticipated that putting such a system in place and operating it will cost $1.3 million over the five years.

The system consists of a network of computers that have the facility of storing data and running various types of programs, such as the pests of numerous crops and their control measures and pest emergence or crop development models, respectively. The network will develop as a "distributed system" which would have the desirable features of (1) being able to accommodate additional capacity or facilities as demanded which would provide a great deal of flexibility in operation of the system; (2) having rapid response times (seconds to minutes) to queries because the design capability of the host computer would not have to be exceeded; (3) the host computer would be of type known as "midi" which has minimal environmental requirements for the equipment while having adequate memory and data storage capacity for a number of functions within a system; (4) having the capacity for adaptation of programs to the local level and accessibility at the local level, thereby reducing costs to the user resulting from telephone charges; (5) incorporating the ability to enter data at the local level for use locally and in statewide models, via input to the host computer and dissemination to users in other locales; and (6) communicating fast-breaking IPM news items throughout the system for rapid local dissemination.

This proposal encompasses the establishment of a host computer to handle the research programs associated with IPM, includes the development of appropriate software for IPM data base management, establishes 12 "intelligent terminal" sites within the state to serve as pilot areas to work out the software requirements for the system, and provides for expansion as needed to the whole State with many crops.

The proposed computer system is designed to support a program development and research staff of 6 individuals, and additional capacity to allow research use and program development by off-site (remote) research and extension personnel. The following requirements are implicit in the proposed hardware costs:

(1) Support up to 24 simultaneous terminals in use:
    6 on site (research center)
    12 remote (county use)
    6 spares

(2) Support fast execution of floating-point, CPU-bound simulation programs.

(3) Support rapid program development (fast, efficient compilers, high capacity processing system).

(4) Have a proven, flexible, time-sharing operating system.

Biological programs and simulators are typically heavy users of the CPU. It is, therefore, most prudent to select a machine with demonstrable capability of fast execution times.

The use of a manufacturer-supplied Data Base Management System may degrade performance of the system, since these programs make heavy demands on a computer's capabilities. Specialized data management programs will be considered to lower the computational burden and increase the computer's reliability and speed. However, a Data Base Management System should be considered for future large-scale, implementation projects.

Solving IPM problems in field application requires fast access to weather data that correlates with growth of plants, insects, diseases, and other organisms. The specialized weather entry/ retrieval programs which store and use up to seven separate weather measurements provide the necessary weather data. For an IPM system it is assumed that storage capacity for weather data will be needed for three stations per county and for three years. If the data is gathered hourly then about 26 megabytes of data storage would be required for weather.

Field data storage requirements are based on past experience with alfalfa production and Egyptian alfalfa weevil populations. Under complete research-oriented data sampling, one person will collect about 400 bytes of information per day. Considering the length of growing seasons, numbers of crops, kinds and numbers of pests and adequate sampling, an estimate of 6 megabytes storage capacity is needed for the delivery system for field application.

The central computer that meets the field as well as research needs costs approximately $325,000, and has the following specifications:

200 megabytes of disk storage
1 to 2 megabytes memory
32 bit CPU or advanced 16 bit CPU
1 tape drive (800/1600 BPI)
1 300 line/minute printer
system console
time sharing operating system
Fortran, Basic Hardware floating point
Fast data channel (5 to 10 megabyte/sec)

Associated with the central computer are modems and terminals at the host location and in the 12 field locations, costing as follows:

Terminals (remote)		
12 remote terminals $5,000 each (includes CRT screen and hard copy printer)		$60,000
24 high speed modems (1200 baud) @ $1,000 each		24,000
Terminals (local)		
6 local terminals @ $2,500 each		$15,000
6 dialup modems (1200/300 baud) $1,000 each		6,000
	TOTAL	$105,000

Budget for the computer system installation is as follows:

Central computer		$325,000
Modems and terminals		105,000
Line costs using Telpak		55,000
Extra start-up costs		15,000
	TOTAL	$500,000

It is understood that half of this amount ($250,000) is in the augmentation request for 1979/80. Other costs include two computer technicians/trainers ($65,000) and supplies and expense ($80,000).

Total for computer establishment and operation 79/80 is $395,000

5. Field implementation:
An IPM program is of no value unless it can be implemented in the field. Responsibility for implementation falls for the most part on Cooperative Extension. However, CE's pest and disease management staff and resources are stretched to the limit with present program obligations. To assist in rapid implementation of information and IPM practices developed through the project, one IPM Coordinator will be hired in 79/80 and a second in 80/81. It is proposed to hire six IPM Area Farm Advisors in 79/80. These advisors will be located in key county offices of CE, will have cross-county assignments and will implement IPM practices at the local level by working with other farm advisors, growers and pest control advisors.

Cooperative research on major crop pests has characterized the approach of the Division of Agriculture. Basic and applied research findings in the Agricultural Experiment Station translate to action programs in the field by Cooperative Extension Specialists and Farm Advisors and by farmers and pest control advisors. The Department of Food and Agriculture, U. S. Department of Agriculture, and the National Weather Service have interests in this project and will contribute to it as well as receive and use the results in their programs.

SCHEDULE OF PROJECT DEVELOPMENT

A project of this size requires a timetable of events (attached).

Several items are of particular importance. It is a goal of the project to publish preliminary Pest Management Manuals as selected crops immediately following the in-depth literature review and assimilation of applicable information (task 5). Much potentially useful information is presently not utilized because it is disorganized or not correctly interpreted. This task may continue.

A second important immediate task is to initiate the development of a computer-assisted communications network (task 9). This would be in place in key counties by 1982.

Task 10 in essence is the key project goal. Targets are established for completing IPM programs on alfalfa and cotton (1982), apples, grapes and tomatoes (1983) and citrus (1984). Completion of an IPM program does not mean the many components of the program will not be implemented in the field as soon as available. Implementation of effective pest management tactics is an ongoing practice.

SCHEDULE
U.C. STATEWIDE IPM PROJECT

TASK (Technological Objectives)	1979-80	1980-81	1981-82	1982-83	1983-84
1. Organize Advisory and Technical Committees	⟷				
2. Identify special staff needs, develop job descriptions, advertise and hire	⟷				
3. Organize, establish goals and fund project analysis staff	←	—	—	—	—
4. Review in-depth all pest management literature on selected crops	⟷	→			
5. Publish preliminary Pest Management manuals on selected crops		⟷	→		
6. Identify data gaps and call for research proposals on specific projects	⟷	→			
7. Review project proposals, select suitable proposals and fund		⟷	⟷	→	
8. Review projects for progress, continue funding or terminate			←	—	— ;
9. Develop computer network a. Fund for planning and equipment purchase b. Establish phase 1 of network, start programming c. Phase 2, additional counties, utilization	⟷	⟷	⟷		
10. Schedule of crop IPM program development and implementation a. Alfalfa and cotton b. Apples, grapes, and tomatoes c. Citrus	←	—	— →		
		←	—	— →	
			←	—	— →

ADMINISTRATIVE STRUCTURE

Administration of the program will be the responsibility of the Vice President for Agriculture and University Services working through the Program Director who receives advice from the Policy Committee and who directs the Technical Committee. The Program Director is responsible for the operation of the program with the aid of an Associate Program Director.

POLICY COMMITTEE

The Policy Committee will have the responsibility of representing the program to administrators within the Agricultural Experiment Station branches on the three campuses and of incorporating aspects of their suggestions, as appropriate, into the program's policy framework. The Policy Committee will also evaluate the needs of the state for IPM programs, review present human and monetary resource commitments, and establish priorities for program development. In making decisions for program priorities relative to crops and associated pests, the Policy Committee will consider input from the Technical Committee, the Program Director, and the Associate Director. In addition, the Policy Committee will consider the needs for pest management as represented by the California Department of Food and Agriculture, the United States Department of Agriculture/Science Education and Administration/Agricultural Resources, and the Environmental Protection Agency. Special efforts will be made to assure coordination with USDA programs in IPM and the needs of the CDFA. The committee will be appointed by the Vice President including the following and others as desirable:

Assistant Vice President for Agriculture - Chairman
Program Director
Associate Program Director
Associate Deans for Research
- U.C. Davis
- U.C. Berkeley
- U.C. Riverside

Assistant Director, Cooperative Extension
Representative, Department of Food and Agriculture
Representative, USDA/SEA/AR
Representative, EPA District #9

TECHNICAL COMMITTEE

The Technical Committee is responsible for developing, within the general guidelines established by the Policy Committee, the research priorities. It will also decide which proposed projects and sub-projects should be funded. This committee will develop a detailed outline of the areas of research that need to be completed and will solicit formal grant proposals from University staff to meet these needs. The Technical Committee will recommend to the Director of the program the approval and/or disapproval of sub-projects. The Technical Committee will be appointed by the Assistant Vice President with the recommendation of the Program Director.

Program Director-Chairman
Associate Program Director
Crop Project Officers
Representative Analysis Staff

Representative Computer/Programming Staff
Representative Cooperative Extension Implementation Staff

The Technical Committee, under the leadership of the Program Director, will be responsible for coordination of the activities of the core analysis staff, the computer/programming staff and interfacing with the CE implementation staff. The CE implementation staff will be under the direct supervision of the Assistant Director CE in charge of the Pest and Disease Management Program.

COORDINATION WITH THE DEPARTMENT OF FOOD AND AGRICULTURE (DFA)

Missions and responsibilities in IPM differ between DFA and UC. The Department enforces state and federal regulations as stipulated by the Legislature and the Governor. UC does basic and applied research into IPM, teaches the subject to students, and maintains an informational, training and service function in every county through Cooperative Extension. UC assumes the responsibility for developing IPM programs throughout the state. Overlapping activities between DFA and UC are minimal because of coordination at all administrative levels.

The Director of DFA and the Vice President of UC for the Division of Agricultural Sciences are in frequent conversation. Department heads in DFA, Deans on three campuses, and those administering research in the Vice President's office have met regularly on a program basis, especially the needs for pest management. This IPM proposal has developed out of these two groups working together. At the field level where research and regulation are accomplished, people from DFA and UC work together on specific problems. Examples include the coordinated research and control of pink bollworm of cotton and of Dutch elm disease. It is planned that DFA will be represented on the Core Group and Advisory Committees in the University's IPM program.

DFA needs data and integrative facilities for regulatory purposes often in specific situations where data are not available, thus there is need for research to meet the specific problems of DFA. On the other hand DFA collects data on pest populations and pesticide use, which will be useful in the integration process of the IPM program. In fact the UC program needs the help of DFA for data and regulations on control of movement of plants and animals, monitoring of diseases and insect population levels, and treatments to accomplish pest controls.

In summary, DFA will benefit from the research, from the coordination of their own studies and regulatory requirements with the overall data bank, and from the predictions of pest control needs through the computer network. The UC IPM program will benefit from the monitoring accomplished by DFA and their help in regulatory actions and establishment of large-scale treatments Integration in IPM is interagency as well as interdisciplinary.

OVERALL PROGRAM
5-Year Budget Projections

	79/80	80/81	81/82	82/83	83/84
	---------- Dollars in thousands ----------				
Computer (lease first year)	395	500	230	100	100
Personnel	340	570	650	715	785
Supplies	60	100	110	120	130
Grants for specified research	330	1,000	1,065	1,065	985
	1,125	2,170	2,000	2,000	2,000

APPENDIX IV

IPM Language as Approved by the Legislature and the Governor

Item No.
346.1 Integrated Pest Management

The University of California (UC) shall include at least one representative of the Director of Food and Agriculture on the policy and technical committees which are charged with making policy and funding recommendations to the project director and the Vice President for Agricultural Services.

UC shall prepare a multi-year work plan to guide research relating to integrated pest management. UC shall allocate any funds made available by the Legislature for integrated pest management in accordance with the priorities and criteria set forth in the plan.

In preparing the plan, the UC shall familiarize itself with the environmental assessment of pesticide use and regulations completed by the Department of Food and Agriculture in 1979 and shall, insofar as-they are completed, address the actions recommended in that report in its research program plan. The UC shall, further, familiarize itself with the process by which the Resources Secretary is currently reviewing state pesticide regulations for their environmental protection sufficiency and shall, in the research program plan, address any issues identified in that process to the extent they relate to integrated pest management and to the extent that this process is completed.

The UC will, in the preparation of the plan, consult with the Department of Food and Agriculture, Resources Agency, and the Department of Health Services.

The research program plan shall be submitted to the Joint Legislative Budget Committee and the appropriate policy committees of the Legislature by March 1, 1980.

UC shall report to the legislative budget committees and the appropriate policy committees by January 1 of each year on the progress of the statewide integrated pest management program, including a list of research grants funded by the program in the previous year. The report shall also describe how research priorities in integrated pest management identified by the Director of Food and Agriculture are addressed by the statewide integrated pest management program and the reason for any differences in priorities between the director and the University. Finally, before purchasing any computer equipment, the University shall thoroughly evaluate its computer equipment needs. In particular, attention should be given to: (1) leasing rather than purchasing equipment, (2) utilizing a commercial time-sharing service, and (3) coordinating with the Department of Food and Agriculture's pesticide information systems. The January 1, 1980 report shall provide the details of the computer equipment augmentation program.

It is legislative intent that UC attempt to reallocate internal resources in order to increase support for integrated Pest Management in 1980-81 to a total of $2 million.

APPENDIX V

December 11, 1979
Attendees: Advisory Committee Meeting

Name	Address
John R. Anderson	Entomology, UC Berkeley
*Mel Androus	Rice Research Board, Yuba City
Forrest Cress	Cooperative Extension, UC Riverside
*Thomas F. DiMare	DiMare Bros. Farms, Newman, CA
*Dan Dooley	CDFA, Sacramento
*Ric Dunkle	CDFA, Sacramento
*Dana Fisher	Fisher Farms, Blythe, CA
Mel Gagnon	Cooperative Extension, UC
*J. E. Gilmore	USDA, SEA/AR, Fresno, CA
H. F. Heady	Vice Presidents Office, DANR, UC
Mary Jo Henry	Budget Office, President's Office, UC
Charles E. Hess	Dean, College of Agr. & Env. Sci., UC Davis
J. B. Kendrick	Vice President, DANR, UC
C.S. Koehler	Cooperative Extension, UC Berkeley
Lowell Lewis	Assoc. Dean, College of Agr., UC Riverside
*Bill Lingren	WACA, Palo Alto, CA
J. M. Lyons	Interim Director, Statewide IPM Program
*John Marcroft	CAPCA, Salinas, CA
*Earl Mortenson	CA Dept. Health Services, Sacramento
*Richard Nagaoka	Napa Valley Vineyards, Rutherford, CA
*John Nakamura	Nakamura Farms, Firebaugh, CA
Daniel Rabovsky	Legislative Budget Committee, State Capitol
*R. E. Rominger	Director, CDFA, Sacramento
Jesse D. Shaw	Budget Office, President's Office, UC Berkeley
Gary Smith	Cooperative Extension, UC Berkeley
M. W. Stimmann	Cooperative Extension, UC Davis
C. G. Summers	Entomology, UC Parlier
*Jeane Thom	El Cerrito, CA
Jack Toigo	Assembly Ag. Committee, State Capitol
A. R. Weinhold	Plant Pathology, UC Berkeley

*Representing organizations invited to join the Advisory Committee

Invited organizations not present were:

CA Farm Bureau Federation	Frederick J. Keringern
CA Dept. of Industrial Relations	Donald Vial
Environmental Defense Fund	
Environmental Protection Agency	Robert Kuykendall
CA Dept. Environmental Affairs	Richard P. Spohn
United Farm Workers	Cesar Chavez

APPENDIX VI

December 1980
Legislative Budget Report

Office of the President
University of California

Statewide Integrated Pest Management (IPM) Project

Budget Report
December 1980

SUMMARY

During its first full year of operation, the Statewide IPM Project has exerted a significant influence on research and Cooperative Extension pest management activities within the University of California. It has served as a focal point and a catalyst for interdisciplinary research in the pest disciplines, crop sciences, plant physiology, biometeorology, computer science and economics. The project has improved the dialogue among scientists on the various University campuses, among research and Cooperative Extension staff, and among University personnel and those responsible for pest management and pesticide regulation in the California Department of Food and Agriculture (CDFA). The project is ultimately aimed at implementation of Integrated Pest Management (IPM). The major avenues for field dissemination of research-derived information are now being put into place.

A budget augmentation of $1.25 million was provided to the Statewide Project in 1979-80 and $1.56 million in 1980-81. Specific accomplishments during this period include:

- Organization of advisory and technical committees.

- Initial staff hired or being recruited. This includes four IPM analysts, a Cooperative Extension IPM Specialist, seven Extension area IPM Specialists, and computer and IPM manual staff.

- Identification of data gaps and high priority IPM research needs in alfalfa, cotton, grapes, citrus and almonds, and cross-commodity research on vertebrate pest management and on weather data collection. Grant funds totaling $251,000 were allocated for 1979-80 and $726,000 for 1980-81.

- Organization of Extension implementation staff. A Statewide Coordinator is located on the Davis campus, and five area specialists are now operating out of county offices throughout the state; recruitment for two additional area specialists is underway.

- Selection and purchasing of computer equipment, initiation of site preparation for installation, hiring of programmers for Davis, Riverside, and Kearney Field Station. Funds totaling $641,000 in 1979-80 and $200,000 in 1980-81 have been directed towards purchase, maintenance, and operation of the computers.

- Preparation of drafts for IPM manuals in alfalfa, tomatoes, walnuts, rice, and grapes in cooperation with commodity work groups. At the same time, a prototype table of pesticide alternatives is being developed which will complement the manuals and serve CDFA's regulatory needs.

- Review and funding by the Technical Committee of research projects in five commodities, establishment of computer system policy and review criteria for evaluating and funding future research.

- Allocation of budget augmentation funds with projections that include:

(Dollars in Thousands)

	1979/80 (Estimated)	1980/81 (Actual)	1981/82 (Estimated)		
Computer System	$ 641	$ 200	$ 260	$ 175	Personnel
	175	500	503	550	
Supplies and Expenses	58	80	71	80	
Grant Funds	251	720	726	755	
	$ 1,125	$ 1,500	$ 1,560	$ 1,560	

- Reallocation of internal resources include an estimated 13.0 FTE or $650,000 of UC staff time and $1,015,520 of extra mural support from grant funds from public and private agencies to individual researchers.

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INTRODUCTION

Background

Item 361 of the 1980 Budget Conference Committee's Supplemental Report on the Budget Bill recommended that:

UC shall, not later than December 15, 1980, submit a report to the legislative budget commit updating the reports and plans regarding integrated pest management which were submitted to various legislative committees pursuant to the supplemental language of Item 346.1 of the Budget Act of 1979.

The 1979 Supplemental Language required two reports, as follows:

The University of California (UC) shall include at least one representative of the Director of Food and Agriculture on the policy and technical committees which are charged with making policy and funding recommendations to the project director and the Vice President for Agricultural Services.

UC shall prepare a multi-year work plan to guide research relating to integrated pest management. UC shall allocate any funds made available by the Legislature for integrated pest management in accordance with the priorities and criteria set forth in the plan.

In preparing the plan, the UC shall familiarize itself with the environmental assessment of pesticide use and regulations completed by the Department of Food and Agriculture in 1979 and shall, insofar as they are completed, address the actions recommended in that report in its research program plan. The UC shall, further, familiarize itself with the process by which the Resources Secretary is currently reviewing state pesticide regulations for their environmental protection sufficiency and shall, in the research program plan, address any issues identified in that process to the extent they relate to integrated pest management and to the extent that this process is completed.

The UC will, in the preparation of the plan, consult with the Department of Food and Agriculture, Resources Agency, and the Department of Health Services.

The research program plan shall be submitted to the Joint Legislative Budget Committee and the appropriate policy committees of the Legislature by March 1, 1980.

UC shall report to the legislative budget committees and the appropriate policy committees by January 1 of each year on the progress of the statewide integrated pest management program, including a list of research grants funded by the program in the previous year. The report shall also describe how research priorities in integrated pest management identified by the Director of Food and Agriculture are addressed by the statewide integrated pest management program and the reason for any differences in priorities between the director and the University. Finally, before purchasing any computer equipment, the University shall thoroughly evaluate its computer equipment needs. In particular, attention should be given to: (1) leasing rather than purchasing equipment, (2) utilizing a commercial time-sharing service, and (3) coordinating with the Department of Food and

Agriculture's pesticide information systems. The January 1, 1980 report shall provide the details of the computer equipment augmentation program.

Response to both parts of the Budget Conference Committee's request is made in this report.

Integrated Pest Management: Definition, Needs, and Progress

Integrated pest management (IPM) is an ecologically based pest control strategy and is part of the overall crop production system[1]. Pests and the need to take actions to control them are assessed according to their potential impact on crop production in the context of the specific field ecosystem. A consideration of the influence of variables of climate, crop maturity, physical environment, interacting organisms, and time of the year is essential to this assessment. By taking a broad ecosystem, season-long view, IPM systems can take maximum advantage of natural mortality factors such as biological control and pest-inhibiting environmental or climatic conditions, and employ control tactics which preserve or augment these factors. For example, pesticides are applied when their need is indicated by the results of a scientifically-based field monitoring program and in accordance with established decision making guidelines. Choice of material, application rate, and method of timing of pesticide sprays are selected to be minimally disruptive of natural mortality factors. Ideally, IPM programs are unified management programs which consider all available actions (including the option of taking no action) and which evaluate potential interactions between various control tactics, cultural practices, weather and physical factors, other pests, and the protected commodity. IPM programs present a consolidated management plan to avoid economic damage from pests and optimize yields and crop quality yet minimize adverse effects on the environment.

Generally, the grower has intuitively (although, because of inadequate information, sometimes not very effectively) considered many of these factors when making management decisions. Pest control scientists and specialists, seeking precise information on which to base their recommendations and conclusions, have been forced to focus on discreet units of the production system to produce reliable information. This specialization in research efforts was required to obtain basic biological information and has yielded great rewards in terms of development of sophisticated control tools and in furthering an understanding of pest biology. However, with little coordination of research among different disciplines, there has, in many cases, been inadequate assessment of the overall impact of pest complexes on crop production in the context of the surrounding agro-ecosystem. Until recently, this has been largely unavoidable because there has been no means to consider simultaneously the hundreds of variables which may be influencing pest populations or crop production at any one time and to determine the optimum pest management strategy in a given situation. Now, however, the capability exists, through the use of computer simulation and optimization models, to consider a vast array of interacting-variables and potential management practices and to make management decisions which integrate information relevant to all crop production disciplines.

[1] In this report the word pest is used to denote insects, nematodes, weeds, disease organisms, and vertebrates -- not just insects.

A note of caution is in order, however. This new science—ecosystems analysis—is in its infancy. A complete ecosystem model in any crop is still in the future and unrealistic expectations should be avoided. To date, no model fully considers plant disease control, insect control, and weed control interactions in one crop. Because of the unpredictability of weather, use of models to make accurate, long-term predictions of yields cannot be expected in the foreseeable future. On the other hand, there are some very good models which interrelate weather, key pest activity, crop development, and management practices. These are now ready to assist growers in making optimal insect control decisions concerning cotton and alfalfa in California. As a result of these models, the period when the major insect pest (the lygus bug) in San Joaquin Valley cotton is potentially damaging has been narrowed down from several months to a few weeks. It has also been determined that the cotton plant is much more tolerant to lygus damage than previously believed. This knowledge has, over the past eight years, resulted in improved pest monitoring programs, more accurate potential damage assessments, and a reduction in unnecessary and costly insecticide applications in commercially grown cotton in this area of California. In alfalfa, the computer model confirmed earlier speculation that insecticide application for control of the Egyptian alfalfa weevil is more effective when applied to adult weevils in mid-winter than to larvae in the spring when applications have normally been made. The model has also enabled evaluation of the impact of weedy fields on weevil populations and will probably eventually allow inclusion of a weediness factor when making weevil control decisions.

In developing similar information on other crop ecosystems the University will continue to depend on the agricultural scientists and the specializations which have resulted in major pest control innovations in the past. The Statewide IPM Project will, in addition, use mathematical models to link up the results of previously disparate research efforts and will serve as a focus for coordinating multidisciplinary research. In this way, information generated by different workers involving the same crop can be compiled and interrelated, research gaps can be identified and filled, duplication eliminated, and priorities agreed upon. Implementation of IPM in the field, however, and changes in the way pests are managed do not need to wait until crop ecosystem models are fully perfected. Current programs for a number of crops confirm this position. At present, sufficient information and technology are available to do much to implement the central IPM philosophy of "consider the ecosystem". For several pests such as pink bollworm, codling moths and fireblight, simple temperature- and population-count-driven models have increased the accuracy of decision making manyfold and, in doing so, have eliminated many costly pesticide applications. Field monitoring programs carried out by trained pest control advisors (PCAs) can make a big difference in any crop. Little-known monitoring techniques and decision making guidelines need to be verified and then brought into more widespread use. Known information on the impact of climate, natural enemy populations, management practices, and pesticide applications on pest populations, if more widely disseminated, would be instrumental in promoting a more integrated approach to pest management in the immediate future.

The key to IPM is designing a cohesive strategy. Such a strategy involves planning ahead to minimize pest problems in the first place, carrying out an effective field monitoring program, and having sufficient information to make timely and appropriate pest control decisions. The University is in the process of preparing IPM Manuals for major agricultural crops, which will present such strategies for the range of crop pests in a clear, concise, and comprehensive form, using the best current knowledge available. For many crop pests useful guidelines are crude or nonexistent.

However, careful field-monitoring programs and better understanding of pest biology, pesticide impacts, and crop vulnerability will greatly improve pest control decision making between now and the time when computer models are available to assist in making these decisions.

Responding to the Report on the Environmental Assessment of Pesticide Regulatory Programs

In its review of State pesticide use and regulatory policy published in September, 1978, the California Department of Food and Agriculture's (CDFA) Environmental Assessment Team made recommendations and conclusions in two broad areas. The first involved the need for public input into pesticide regulatory decisions which have the potential to affect public health and the environment significantly. The second stressed the need for further developing and increasing reliance on pest control strategies, notably IPM, which are economical and - effective yet pose the least risk. While the University has no regulatory responsibilities in regard to pesticide use, it does carry the major responsibility for developing new methods of controlling pests and educating the public about their availability and use.

Two recommendations in the Environmental Assessment Team's Report specifically addressed University responsibilities. Recommendation #19 suggested that the University cooperate with CDFA in the preparation and updating of pest management information documents which describe recommended pest management systems, including pests, pest monitoring procedures, economic thresholds, pesticides and application rates, pesticide hazards, other control methods and other considerations involved in managing pests in a commodity. Recommendation #59 states that the University should be encouraged to expand its research in alternative pest control strategies, specifically IPM, and mitigation measures which would reduce pesticide hazards.

Both of these recommendations are being addressed in the work funded by the Statewide IPM Project. Page 20 of this report discusses the University's efforts in preparing IPM manuals. This is being done in consultation with CDFA which has a representative on the IPM Manual Committee. CDFA will also participate in the preparation of pesticide information and review of the manuals. As the distributed computer network (DCN) (see Page 17) comes on line, it will provide constantly updated pest management and pesticide information, of the sort described in Recommendation #19, to County Agricultural Commissioners, Farm Advisors, Growers, and PCAs. The manuals and the DCN will assist decision making and greatly reduce paperwork for Commissioners carrying out the provisions of the new State pesticide use permit issuance regulations.

State funding of this expanded IPM project reflects an effort on the part of the Legislature to meet the suggestions of Recommendation #59. From the 1980-81 appropriation, funds totaling $627,000 have been granted to scientists pursuing research to develop and implement IPM strategies. Additionally, the DCN, funded in the 1980-81 budget, will serve as a major IPM research tool for years to come.

In choosing commodities for research funding, two major considerations were the degree of the use of pesticides and the potential for rapid implementation of IPM. The three crops now receiving most of the grant funds are among the top seven commodity users of restricted pesticides; rank first, second, and third in economic value among non-animal farm crops grown in California; and have

been identified as the crops in which a concerted effort will most rapidly yield a cohesive, multidisciplinary IPM program for grower use. Finally, the interdisciplinary and interagency participation involved in the planning and review of all aspects of this program is a demonstration of the kind of interagency consultation and cooperation recommended in the Environmental Assessment Report.

Project Development and Future Plans

During its first full year of operation, the Statewide IPM Project has exerted a significant influence on research and on Cooperative Extension pest management activities within the University of California. It has served as a focal point and a catalyst for interdisciplinary research in the pest disciplines, crop sciences, plant physiology, biometeorology, computer science, and economics. The project has improved the dialogue among scientists on the various University campuses, among research and Cooperative Extension staff, and among University personnel and those responsible for pest management and pesticide regulation within the CDFA.

The project is ultimately focused on implementation of IPM. Major portions of its budget are designated for communicating the most up-to-date IPM information to growers and PCAs via the publication of crop specific IPM manuals and the Statewide computer system. Five Cooperative Extension Area IPM Specialists have been hired and assigned to various locations in the State to serve as local sources of information and to coordinate regional IPM activities. Cooperative Extension is intimately involved; the current project director is Pest Management Program Director in Cooperative Extension. Extension specialists and Agricultural Experiment Station researchers serve on the Technical Committee and farm advisors participate along with researchers in the Commodity Work Groups. The accomplishments of the Statewide IPM Project are discussed in this report and are compared with the time schedule originally established (see Figure I and Table 1).

Figure 1

SCHEDULE

U.C. STATEWIDE IPM PROJECT

April 19, 1979

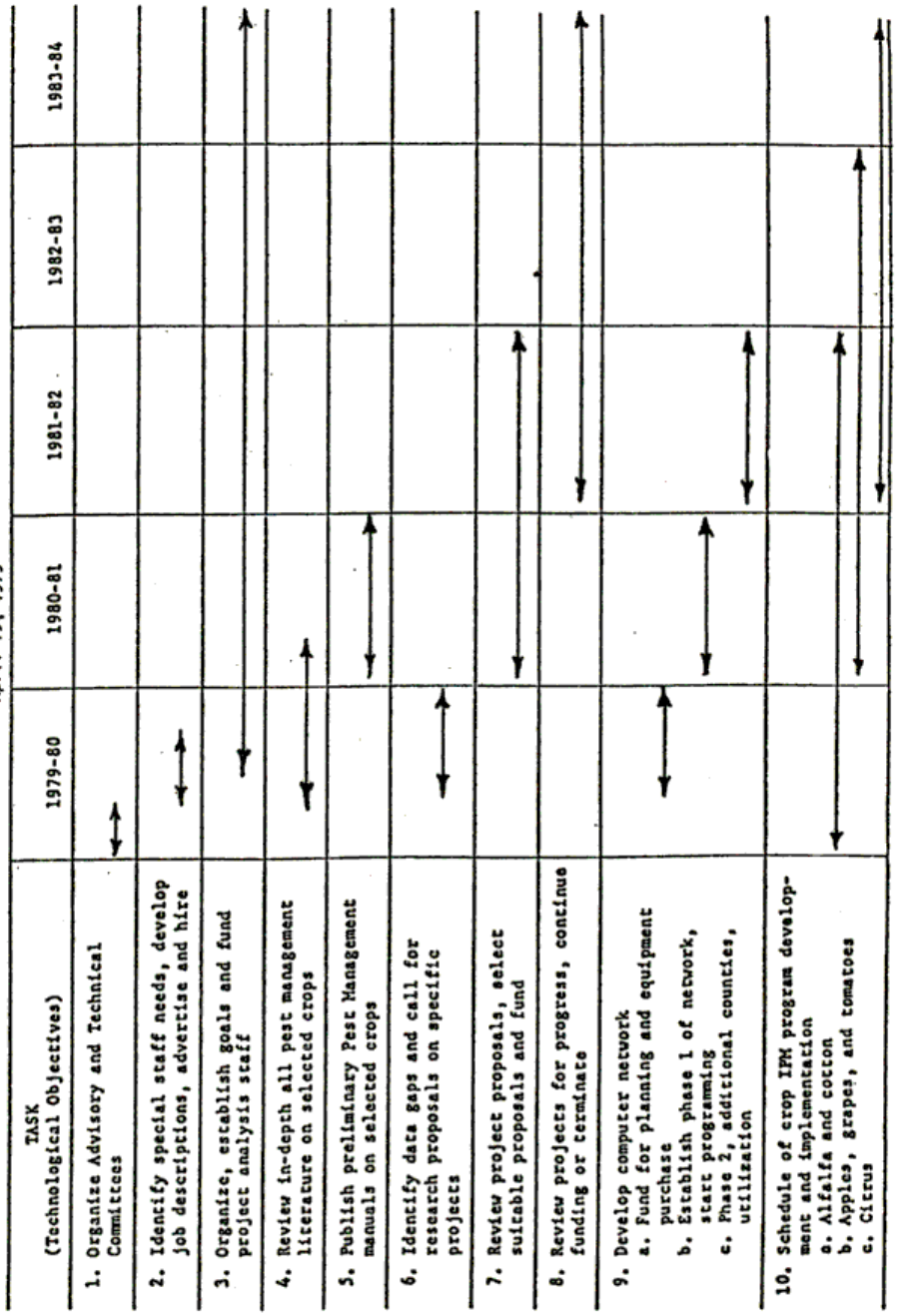


Table 1

NOVEMBER, 1980 STATUS OF PROJECTED
TASK SCHEDULE IN FIGURE I

1. Organization of advisory and technical committees: completed.

2. Staffing: initial staffing needs accomplished with the exception of hiring two more Area IPM Specialists.

3. Establishing goals and funding: ongoing process.

4. Review of literature: ongoing process, although substantially completed for alfalfa, grapes, cotton.

5. IPM manuals: alfalfa, grapes, tomatoes, walnuts, and rice will be published in 1980-81.

6. Identify data gaps; call for research proposals: completed for alfalfa, cotton, grapes.

7. Review project proposals- ongoing.

8. Review progress: ongoing.

9. Develop distributed computer network: on schedule, equipment purchased, programming begun, site preparations at Davis, Parlier, Riverside underway.

10. Crop schedules --

    a. Alfalfa and cotton: on schedule

    b. Apples, grapes, and tomatoes: almonds substituted for apples, grapes on schedule, tomatoes behind schedule.

    c. Citrus: ahead of schedule.

As reflected in Figure 1 and Table 1, the project is meeting its schedule of technological objectives essentially on time. This has been accomplished through the commitment of the administrators of the Division of Agriculture who have been strong supporters of the project. They have willingly committed the time of Experiment Station Researchers and Cooperative Extension Specialists and Farm Advisors to project activities (see membership of Commodity Work Groups). In most cases, not only is the time of the individuals given to the project but travel and per diem expenses are also covered by other than IPM Project funds. CDFA administration has also been supportive and many hours of time of specialists in the CDFA IPM Unit have been spent on project activities.

Perhaps the keystone to the success of the project is the philosophical commitment to multidisciplinary, multicampus cooperation, commitment which becomes functional in the Commodity Work Groups. Successful work groups are absolutely dependent on identifying either a research scientists or a specialists with broad knowledge of the ongoing research in the particular crop. This individual must also know the personnel in the State who are active in research on the crop. Commodity Group Leaders must be able and willing to dedicate a large part of their time to leadership of the Commodity Work Group. This takes organizational skills and great tact to pull normally highly individualistic and independent scientists together as a team to work effectively toward a common goal. This has been accomplished for alfalfa, cotton, grapes, almonds, and citrus, and active and effective work groups have been established. In 1981, it is expected that leadership will be identified and effective work groups will be developed for tomatoes, walnuts, and apples.

The rapidly increasing cost of operations and salaries, reflecting national inflation, has caused project management concern about the ability to maintain the initial rate of progress. In addition to inflation, funding has been lower than originally planned.

The initial success of the project has created interest on the part of animal scientists in a possible livestock and poultry IPM subproject. There is also active interest on the part of persons working in the urban IPM area. However, the project will have to have greater State support or obtain additional support from Federal agencies if such subprojects are to be effectively organized and supported.

Key years for the Distributed Computer Network (DCN) are 1980-81 and 1981-82. The network will be in place and operational in 1981 and will be extensively tested for its usefulness. Selection of counties assures that it will reach agriculturists producing in excess of 70 percent of California's gross agricultural product and utilizing at least 70 percent of the pesticides.

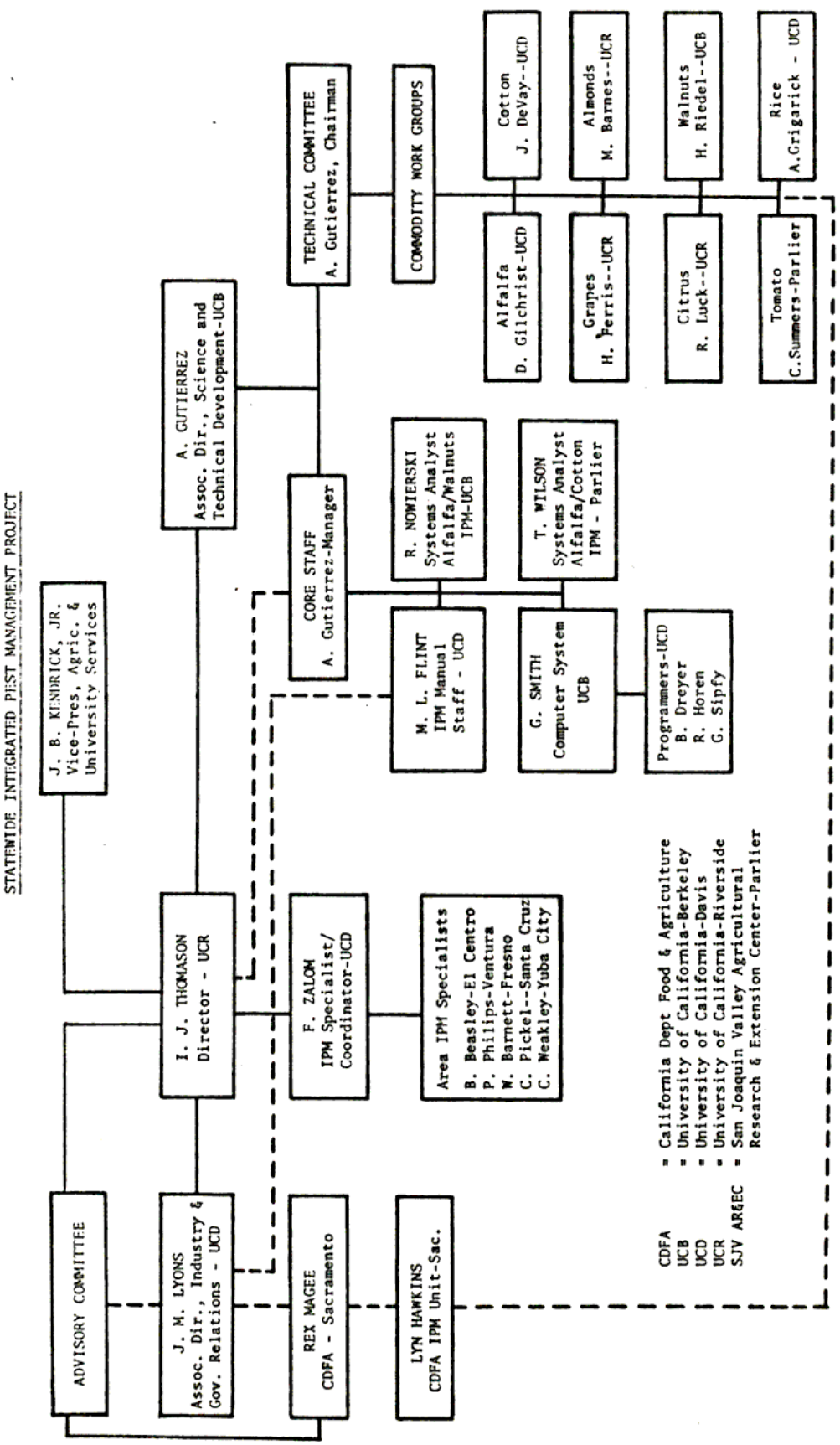
Active discussions continue with CDFA administration concerning joint use of the DCN for dissemination of pesticide registration and regulatory information to County Agricultural Commissioners. Key to joint use are (1) the ability to develop a workable and cost-effective computer program which will adequately organize and display pesticide information (e.g. pesticide ingredient, formulation, crop, pest(s), mitigating measures needed by CACs, PCAs, and Growers); (2) the capacity of the DCN to handle data; (3) the security of the system; and (4) the relative cost to CDFA to use the DCN versus use of State government facilities.

In the planning stage is a joint effort between the IPM Project and the University of California Irrigation Management Information System (CIMIS), a project funded by the California Water Resources Agency. CIMIS is a project being carried out by Cooperative Extension Specialists to improve the efficiency of irrigation water management on California farms. Both the IPM Project and CIMIS will be heavily dependent on our meteorological (weather) network, which will be collecting weather data on a daily basis and analyzing, storing, and distributing the data over the DCN. Joint use of common facilities could lead to considerable savings to the University and the State. The National Weather Service and its local manager, located on the Riverside campus, are actively cooperating with University biometeorologists in the weather network.

ORGANIZATION AND STAFFING

The Statewide IPM Project is directly responsible to the Vice President—Agriculture and University Services. It is headed by a Director who works closely with two Associate Directors in coordinating the project's operation. Three subgroups function under this leadership. University academic research and Cooperative Extension staff participate in the project through membership on Commodity Work Groups or on the Technical Committee. Full-time project staff also coordinate their activities through the Commodity Work Groups or the Technical Committee. Project staff are Core Group members (or associated staff) as Agricultural Experiment Station employees, or are part of the Cooperative Extension implementation staff. An organizational chart for the program is presented in Figure 2. The organizational subunits and their staffs, functions, and accomplishments are discussed in the pages which follow.*

Figure 2


UNIVERSITY OF CALIFORNIA
STATEWIDE INTEGRATED PEST MANAGEMENT PROJECT
12/80
J. B. KENDRICK, JR.
Vice-Pres, Agric. &
University Services
A. GUTIERREZ
Assoc. Dir., Science and
Technical Development-UCB
TECHNICAL COMMITTEE
A. Gutierrez, Chairman
COMMODITY WORK GROUPS
Cotton
J. DeVay--UCD
Almonds
M. Barnes--UCR
Walnuts
H. Riedel--UCB
Rice
A.Grigarick - UCD
Alfalfa
D. Gilchrist-UCD
Grapes
H. Ferris--UCR
Citrus
R. Luck--UCR
Tomato
C.Summers-Parlier
ADVISORY COMMITTEE
I. J. THOMASON
Director - UCR
CORE STAFF
A. Gutierrez-Manager
R. NOWIERSKI
Systems Analyst
Alfalfa/Walnuts
IPM-UCB
T. WILSON
Systems Analyst
Alfalfa/Cotton
IPM - Parlier
J. M. LYONS
Assoc. Dir., Industry &
Gov. Relations - UCD
F. ZALOM
IPM Specialist/
Coordinator-UCD
M. L. FLINT
IPM Manual
Staff - UCD
G. SMITH
Computer System
UCB
Programmers-UCD
B. Dreyer
R. Horen
G. Sipfy
REX MAGEE
CDFA - Sacramento
LYN HAWKINS
CDFA IPM Unit-Sac.
Area IPM Specialists
B. Beasley-El Centro
P. Philips-Ventura
W. Barnett-Fresno
C. Pickel--Santa Cruz
C. Weakley-Yuba City
CDFA = California Dept Food & Agriculture
UCB = University of California-Berkeley
UCD = University of California-Davis
UCR = University of California-Riverside
SJV AR&EC = San Joaquin Valley Agricultural
Research & Extension Center-Parlier

TECHNICAL COMMITTEE

Staff Members

A. Gutierrez (Chair), Entomology, UC Berkeley

S. Aggarwal, Mathematics-Computer Science, UC Riverside

J. Baritelle, Economics, USDA, UC Riverside

M. Barnes, Entomology, UC Riverside

W. Barnett, Area IPM Advisor, CES, Fresno

J. DeVay, Plant Pathology, UC Davis

R. Dunkle, CDFA, Sacramento

H. Ferris, Nematology, UC Riverside

W. Getz, Entomology, UC Berkeley

D. Gilchrist, Plant Pathology, UC Davis

R. Luck, Entomology, UC Riverside

J. Lyons, Vegetable Crops, UC Davis

L. Myrup, LAWR, UC Davis

R. Norris, Weed Science, UC Davis

H. Riedl, Entomology, UC Berkeley

V. Sevacherian, Entomology, UC Riverside

G. Smith, Distributed Computer Network (DCN) Coordinator, UC Davis

C. Summers, Entomology, UC Parlier

I. Thomason, Nematology, UC Riverside

N. Toscano, Extension Entomology, UC Riverside.

Structure

The Technical Committee is chaired by the Associate Director for Science and Technical Development. Membership includes staff members of the University of California from a range of disciplines in academic, research, and extension capacities, who have demonstrated expertise in IPM. CDFA and USDA are also represented. All chairs of currently funded Commodity Work Groups are automatically members of the Technical Committee.

Function

The Technical Committee is responsible for the evolution of the technical and scientific components of the IPM project. Together members of the Technical Committee identify research needs, organize the initial Commodity Work Groups, evaluate commodity group research proposals for funding and for compliance with grant terms, make recommendations for reallocation of funds, and help determine how and when specific research packages should be made available for IPM implementation. The Technical Committee also oversees policy questions regarding the computer network and IPM Manual production.

Accomplishments

Over the last year, the Technical Committee has been a major force in setting up the Statewide IPM Project. Commodity groups have been established in six crops. Research proposals have been received, reviewed, discussed, and funded in five of these. The Technical Committee has also reviewed and is in the final stages of approving a policy statement on the distributed computer system to determine what goes into it, who has access to it, what are the use priorities, and how day today decisions will be made. The Committee is also in the process of developing formal review criteria for funding of future research.

CORE GROUP

Staff

M. L. Flint, IPM Manual Group Director, UC Davis

L. T. Wilson, Cotton-Alfalfa Systems Analyst, UC Parlier

R. M. Nowierski, Alfalfa-Walnut Systems Analyst, UC Berkeley

G. E. Smith, Systems Analyst and Distributed Computer Network Coordinator, UC Berkeley and Davis.

Structure

One Associate Director of the Statewide Project, Dr. A. P. Gutierrez, is responsible for coordinating activities among the Core Group staff, and between the Core Group and other parts of the project. The four Core Group staff members are all trained to the Ph.D. level and have research experience

in ecology and pest management. Within each of the areas of responsibility, Core Group staff members are encouraged to exercise leadership in the development of the IPM Project.

Overall Functions

The Core Group staff is a collection of individuals with rather unique talents related to crop ecosystems analysis. They are the only full-time academic researchers employed by the IPM Project. Although their respective responsibilities are diverse, the four Core Group staff members share a common responsibility to provide a coordinating and integrating focus for the whole program. All interact with several Commodity Work Groups. The original plan for the Core Group staff was to have them housed at one location where they would become technical resource people for the entire project, but because technical people with their specific skills and interests were in short supply in the Division of Agricultural Sciences, they were assigned to specific crops and/or IPM-related activities.

Function of Individual Core Group Staff

M. L. Flint--IPM Manual Group. The development of state of the art IPM Manuals for cotton, alfalfa, grape, tomato, and other crops has been given top priority with the Statewide project. Dr. M. L. Flint is the group leader of that project and is responsible, along with the commodity group leaders, for coordinating the scientific materials that will constitute the text for each of the manuals. Furthermore, Dr. Flint is responsible for all phases of the production of the manuals including review, editing, photography, illustrating, designing, and printing. Dr. Jim Lyons (Associate Director at Davis) acts as her administrative liaison for day-to-day problem-solving.

G. E. Smith--Distributed Computer Network. Dr. G. E. Smith is responsible for the operation of the DCN and associated Statewide computing facilities and their maintenance and for the coordination of software development. He and his staff will determine, in consultation with the IPM Technical Committee, the programming format for IPM computer program implementation. The actual programs selected for IPM implementation will be determined in the same manner. Further, Dr. Smith maintains the necessary communication with CDFA personnel responsible for pesticide regulatory information that is to be implemented on the Statewide network. In addition, he is developing a cooperative project with University meteorology and National Weather Service personnel to assure that the appropriate weather information is available for IPM implementation.

R. M. Nowierski--Alfalfa IPM. Dr. R. M. Nowierski is charged with helping the alfalfa commodity leader develop and implement relevant IPM research. Among his many responsibilities are developing sampling procedures for the numerous insect pests of alfalfa and assisting in the analysis of the role of weeds in alfalfa stand decline. His work involves analyzing data already gathered, as well as participating in the design and development of new research. Dr. Nowierski also carries out IPM research in walnuts.

L. T. Wilson--Cotton IPM. Dr. L. T. Wilson has been employed to help foster the development of the cotton IPM project. His responsibilities include the development of sampling decision rules for cotton pest management field implementation of specific Technical Committee-approved programs, and the development of needed IPM research programs. To date he has been especially involved in

studying the ecology of spider mites in cotton and in assisting in studies to determine relationships between irrigation practices and pest management in cotton. He has also assumed some research responsibilities in alfalfa.

EXTENSION IMPLEMENTATION STAFF

Staff	Initial Commodity Interests
Frank Zalom, Coordinator (Davis Campus)	
Bill Barnett, Central San Joaquin Valley(Fresno)	Alfalfa, almonds, grapes, walnuts
Bud Beasley, Desert Areas (El Centro)	Alfalfa, cotton, tomatoes
Phil Phillips, South Coast Counties (Ventura)	Citrus, grapes, tomatoes
Carolyn Pickel, Central Coast Counties (Watsonville)	Apples, grapes
Craig Weakley, No. Sacramento Valley (Yuba City)	Alfalfa, almonds, rice, tomatoes

Structure

Five county-based Extension Area IPM Specialists and a Statewide Coordinator are now on staff. IPM Specialist and Statewide Coordinator Frank Zalom is located on the Davis campus. The Area IPM Specialists are housed in County Offices and maintain a working relationship with the County Directors and Farm Advisors in the counties in their region. The Extension Implementation Staff reports to Ivan Thomason, Statewide IPM Project Director.

Function

Members of the IPM Implementation staff are charged with initiating, coordinating, and conducting IPM implementation subprojects, practices, and educational programs on commodities of particular concern to the Statewide IPM Project. An Area IPM Specialist serves as a resource to Farm Advisors, county and State regulatory staff, PCAs, and growers. Each operates on a cross-discipline and cross-county basis. They assist in coordinating IPM activities with other specialists, Experiment Station scientists, and interested parties helping to verify IPM practices and models in the field. The Area IPM Specialist represents an important link among advisors, PCAs, and growers in the counties and the University and acts as a channel for the communication of ideas and needs from both sources.

Accomplishments

The major accomplishment this year has been the hiring of the Implementation Staff. Bill Barnett, Bud Beasley, and Carolyn Pickel joined the Statewide Program in May. The Statewide Coordinator, Frank Zalom, was appointed in September. Phil Phillips and Craig Weakley began their

appointments in October. These individuals were selected for their breadth of pest management training and experience and their knowledge of cropping systems. They bring to the Statewide program their prior service to the agricultural community as PCAs, farm advisors, and/or University Extension or Experiment Station employees. While concentrating much of their efforts within predetermined regions, most have extensive knowledge of specific commodities and disciplines which will be used on a broader geographical scale when appropriate. Recruitment has been initiated for Area IPM Specialists to be headquartered in Kern County (southern San Joaquin Valley) and San Joaquin County (Sacramento Valley).

Perhaps the most important initial job of an Area IPM Specialist is to establish rapport with county-based commodity farm advisors and PCAs who have knowledge of the interests and needs of their grower clientele. Implementation of recommended IPM practices in the field cannot be accomplished without enlisting the support of those respected in the agricultural community. In the limited time since their appointments, the Specialists have attempted to make these contacts. They have participated in numerous meetings, classes, and workshops explaining IPM principles and goals. Efforts have been made to reach a greater audience through mass communications including radio, television, and newspapers. For instance, Area IPM Specialist Bill Barnett presents regular "Bug Blurbs" on Fresno radio.

Field verification or implementation projects have been coordinated by Area IPM Specialists in consultation with Extension and Experiment Station personnel. In the past year, projects involving alfalfa, almonds, apples, grapes, and walnuts were conducted. An example of an IPM-related implementation project involved managing the codling moth in apple orchards by using a developmental model of the moth which is linked to physiological time or accumulated day-degrees. In this way injurious stages of the moth can be predicted and insecticides applied if appropriate. Financial support provided by concerned Santa Cruz area apple growers enabled more intensive monitoring of local orchards and demonstration of the management principles. Approximately 75 percent of the growers are estimated to be using IPM principles. The monitoring of orchards for codling moth (as well as apple scab, apple pandemis, and mites) is ready to be incorporated into the private sector. Other projects are described elsewhere in this report.

FIGURE 3


PRIMARY REGIONS OF OPERATION FOR AREA IPM SPECIALISTS
Specialists now on staff
Specialists to be added to staff early 1981
DEL NOTRE
SISKIYOU
MODOC
TRINITY
SHASTA
LASSEN
HUMBOLDT
TENAMA
PLUMAB
MENDOCINO
GLENN
BUTTE
SIERRA
COLUSA
NEVADA
LAKE
PLACER
EL DORADO
SONOMA
NAPA
YOLO
SACRA MENTO
AMADOR
ALPINE
SOLANO
CALAVERAS
MARIN
SAN JOAQUIN
TUOLUMNE
MONO
CONTRA COSTA
SAN FRANCISCO
ALAMEDA
STANISLAUS
MARIPOSA
SAN MATEO
SANTA CLARA
MERCED
INYO
SANTA CRUZ
MADERA
SAN BENITO
FRESNO
TULARE
MONTEREY
KINGS
SAN LUIS OBISPO
KERN
SAN BERNARDINO
SANTA BARBARA
VENTURA
LOS ANGELES
RIVERSIDE
ORANGE
SAN DIEGO
IMPERIAL

DISTRIBUTED COMPUTER NETWORK

Staff Members

Gary Smith, Computer Coordinator, UC Davis

Buz Dreyer, Senior Programmer, UC Davis

Robert Horen, Programmer, UC Davis

Gabor Sepfy, Programmer, UC Davis

Anne Strawn, Programmer, UC Riverside

John Rasmussen, Programmer, Kearney Field Station.

Structure

The Davis site is under the supervision of the Computer Coordinator, Dr. Gary E. Smith. The sites at Kearney and Riverside are under the administrative supervision of Dr. Charles Summers and Dr. H. Ferris, respectively. Their programming operational duties with the DCN are under the supervision of the central computer coordinator.

Function

The Davis central DCN staff is responsible for overall operation of the DCN including hardware and software procurement and maintenance and implementation of the county facilities. The programming staff at Kearney and Riverside devote part of their time to local network maintenance under the direction of the Davis coordinator. The remainder of their time is devoted to assisting local research computing.

Accomplishments

Bid specifications for the DCN were announced in January 1980 after a three month period of analyzing the needs of the University and governmental groups which are associated with the Statewide IPM Project. The initial analysis also included an on-site inspection of two existing agricultural computing facilities in Indiana and Michigan.

Eleven proposed computer configurations from nine manufacturers were received on February 20. Following analysis of these complex proposals, the bid was given to Prime Computer, Inc. in June, 1980. The IPM project selected the Prime system as a result of its support in the areas of:

1. Inter-machine communications in the functionally and geographically distributed computer network;

2. Data base management—to support data storage needs in agricultural field information, pesticide registrational material, meteorology, and research;

3. Scientific computation—to further IPM research projects.

Site preparation for the computers at the Davis and Riverside campuses and at the Kearney Field Station was begun in August. At the same time, IPM administration selected ten county locations for the first set of computer terminals: Fresno, Imperial, Kern, Merced, San Joaquin, Santa Cruz, Sonoma, Sutter/Yuba, Tulare, and Ventura. An order was placed with Pacific Telephone Company for the necessary leased lines and data sets for the intercomputer linkages and these county locations. The county computer terminals and associated printers were tested during July and final approval for purchase given.

During October, three programmers for the central Davis staff were hired. Software development was begun using manufacturer supplied time-sharing amounts on other Prime computers in Northern California. During this same period, a programmer-operator for the site at Parlier was hired. The programmer operator for the Riverside site was hired earlier in the year.

Since announcement of the computer selection in late June, the IPM Technical Committee, computer staff, and administrators have been setting procedures and goals for the IPM network. Administrators for each of the facilities were selected. Procedures are being established to assure quality control over the agricultural information to be included in the computer system. (Computing Facility Sites—Figure 4, page 19.)

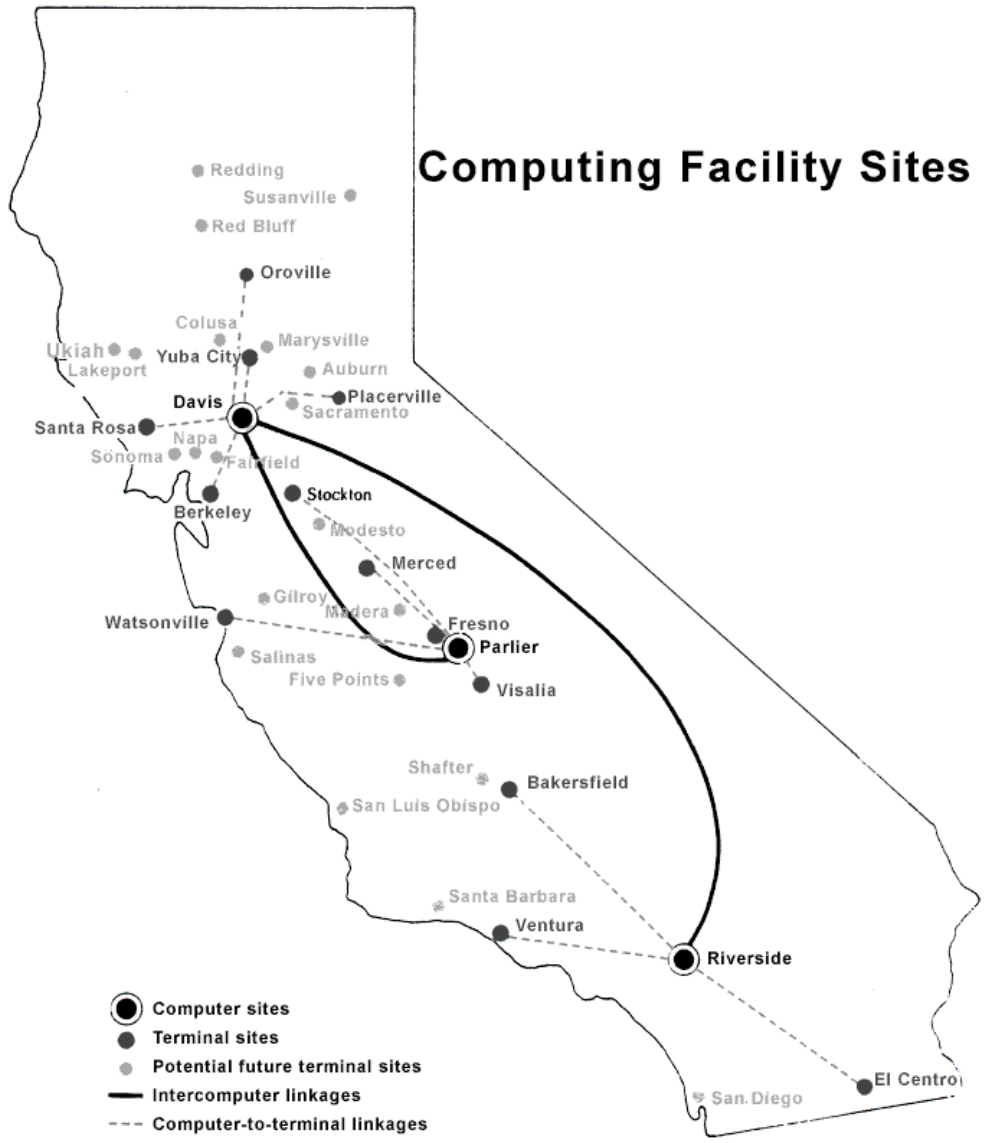
Testing of the overall computer network will begin in February, 1981. By that time, computer linkage and communication procedures will be ready and pretested on other Prime computers. The County terminals will be delivered at that time, and training sessions for county staff will begin. The information and services available on the system will grow through the first few months of 1981, and it is anticipated that basic services will be completed for the 1981 growing season. Three new county sites (Butte, Monterey, and Placerville) have been selected to add to the list of county locations in 1981.

The first thirteen computer terminal sites were selected to assure that regions with the broadest range of agricultural crops, the largest portion of the State's gross agricultural income, and the greatest amount of pesticide use will be accessible through the computer network. Thus, the system will meet the needs of CDFA, the County Agricultural Commissioners, and the University implementation program as rapidly as possible.

During the 1981 growing season, it is anticipated that the DCN will assist Farm Advisors and Specialists with the following computer programs: (1) meteorological data including degree-day models; (2) various statistical and data storage packages; (3) cotton growth model; (4) various phenological (development) models for insects such as lygus bug, Egyptian alfalfa weevil, and pink bollworm of cotton; (5) codling moth management program; and (6) pesticide registration data base storage and retrieval.

In addition, a cooperative effort between the Statewide IPM Project and the California Irrigation Management Information System (CIMIS) will see a joint use of the DCN and a further testing of its utility in irrigation water management on the farm.

FIGURE 4



IPM MANUAL GROUP

Staff Members

Mary Louise Flint, Director

Brunhilde Kobbe, Senior Writer

Paul Rude, Senior Writer

Tobi Jones, Coordinator for Pesticide Directories (a CDFA contract).

Structure

The IPM Manual Group was established in April, 1980, and is located at UC Davis. Its staff includes a Director, two scientific writers, and a secretary. A Cooperative Extension photographer contributes nearly 100 percent of his time to the manual project. Design, editing, and illustration services are contracted out on an hourly basis as is needed. Competitive bids for color separation, typesetting, pasteup, and printing are being requested through the Cooperative Extension Agricultural Publications group. An IPM Manual Steering Committee with representatives from CDFA, Cooperative Extension, and the University Agricultural Experiment Station has been formed to provide input into general manual production issues. IPM Project Associate Director Jim Lyons acts as administrative liaison for the group.

The coordinator for the Pesticide Directories (a related project under contract with CDFA) is housed with the IPM Manual Group and consults with the IPM Manual staff as needed. She works under the supervision of Dr. Jim Lyons, Associate Director of the IPM Project, and Dr. Mike Stimmann, Extension Pesticide Coordinator. A separate committee has been established by CDFA to provide input into the development of these Pesticide Directories.

Function

The IPM Manual Group is responsible for coordinating all aspects of the production of the IPM Project's IPM Manuals. These documents are a key part of the implementation effort and are designed to assist growers and PCAs in using IPM knowledge when making day-to-day decisions in the field. The manuals and the photographic materials developed along with them will also be important communication tools for Area IPM Specialists and Farm Advisors when introducing the IPM concept to new audiences. The IPM Manuals will provide a baseline of current knowledge in each selected crop. Their development will be important in identifying data gaps, research priorities, and implementation needs.

The manuals are coordinated and written by scientific writers in consultation with commodity group members. Initial drafts are substantially revised based on review by researchers and input from grower and PCA representatives.

The Pesticide Directories will provide information in the form of summary tables necessary for CDFA's pesticide regulatory program.

Accomplishments

In the six months of its operation, the IPM Manual Group has prepared draft manuals for four agricultural crops: alfalfa, walnuts, tomatoes, and rice. These drafts are in various stages of development. Over 100 color photographs of pests, natural enemies, and damage symptoms have been taken for inclusion in each manual.

The manuals have been designed as a series and follow a similar format, allowing for modification appropriate to the peculiarities of each crop. They will be approximately 96 pages long. Key features are a general discussion of crop biology and production practices in relationship to pest damage, seasonal monitoring charts and guidelines, and a symptomology key to pest- and stress-induced damage. Four to ten color photos of life stages, damage symptoms, and natural enemies accompany the discussion of each major pest.

The alfalfa manual is in the final stage of development and is illustrative of the process through which the manuals are produced. A preliminary draft was developed in consultation with key Alfalfa Commodity Group members and Experiment Station and Cooperative Extension specialists who work in alfalfa. A subgroup of the Alfalfa Commodity Group representing the disciplines of agronomy, entomology, plant pathology, plant breeding, weed science, vertebrate management, and nermatology was formed to consider questions and conflicting opinions which arose in the review process. The manuscript which was rewritten based on this review has now been sent out to a number of PCAs and growers for comment. After these comments have been considered, a final draft of the manual will be prepared and reviewed by the Alfalfa Commodity Group Leader. It is expected that the publication process will begin in December.

The extensive review of the alfalfa manuscript provided a unique insight into localized problems, interdisciplinary considerations, and the practicality of various management practices. In this way, the manual writing process has been extremely important in identifying research and implementation needs in alfalfa.

Drafts of the walnut (B. Kobbe) and tomato (P. Rude) manuals have been completed and are being reviewed by key University researchers in these crops. It is expected that they will be available for final PCA and grower review and publication in February or March, 1981. A rice manual draft has been prepared by a consultant in cooperation with the Rice Commodity Group. Its publication will follow the walnut and tomato manuals. Manuals for citrus and cotton are in the planning stages.

An IPM Manual for grapes, begun prior to the establishment of the IPM Manual Group, is in press. It was coordinated by Dr. Don Flaherty, Farm Advisor, Tulare County, and written by various members of the Grape Commodity Group.

A special related project which has been undertaken to assist CDFA in solving some of their regulatory needs is the development of Pesticide Directories for tomatoes and two other crops. A coordinator was hired for this project in August. These directories will consist of a series of tables

presenting restricted and major use nonrestricted pesticides and management alternatives for each major pest. The tables will include a synopsis of some of the disadvantages and advantages of each method. They will refer to the IPM Manuals for detailed information regarding methods for monitoring and management. These directories are considered prototypes to be published by CDFA in their final form and updated by CDFA. They are not intended to replace the University's current pest control guides.

As visualized at the present, University/CDFA cooperation would lead to a series of publications that would satisfy the new pesticide regulations. They would be as follows: (1) Guides to Pesticides Registered for Use (CDFA), (2) Pesticide Directories (UC/CDFA), (3) Pest Control Guides and/or Recommendations (UC), (4) Pest Management Manuals (UC), and (5) Keys to Pest Identification (UC/CDFA).

COMMODITY WORK GROUPS

The most important planning unit for research is the Commodity Work Group. Work groups are organized in each crop to review the status of research and pest management implementation, identify data gaps, solicit research proposals, evaluate submitted proposals, and make recommendations to the Technical Committee as to which projects should be funded. Commodity group members also work closely with IPM Manual Group writers in the production of an IPM manual for their crop.

At present, Commodity Work Groups are functioning in alfalfa, cotton, grapes, tomatoes, citrus, and almonds. Leaders for rice and walnut commodity groups have been appointed. Project allocations approved for 1980-81 are listed in the table which follows.

For additional information on the organization and accomplishments of the various commodity work groups the reader is referred to Appendix 11. A brief narrative presentation is given on alfalfa, cotton, and grapes -- crops where the Commodity Work Groups have completed their initial phase of establishing priorities and have significant amounts of research activity funded as illustrated in Table 2.

The Almond and Citrus Commodity Work Groups are primarily in their first phase of activity and their accomplishments are portrayed primarily in tabular form and Illustrates the process of problem analysis and the setting of research priorities. The Tomato Commodity Work Group is in the organizational phase and the accomplishments again are reported in narrative style.

BIOMETEOROLOGY

Accurate and timely weather data are essential to both IPM research and implementation. Thus an early priority of the IPM project is the development of a weather system for the collection and dissemination of weather data. In the past year, biometeorologists have screened current weather systems available in California and surveyed weather needs for existing and developing crop models. This investigation indicates that most of the needed information would be available, with some expansion, through the National Weather Services Touch Tone System. However, methods must be developed to access this and other weather information into the IPM computer system.

A highly successful symposium on the role of biometeorology in IPM was held on the Davis campus on July 15-17, 1980. Planning for the symposium was carried out by Davis Biometeorologist J. L. Hatfield, Davis Plant Pathologist M. A. Sall, and Riverside Entomologist N. Toscano. The goal was to bring together biometeorologists, plant pathologist, weed scientists, entomologists, and other scientists to discuss the current and future directions of biometeorology in IPM. Approximately sixty-five persons, coming from many parts of the United States, participated in the symposium. The latest information on instrumentation, weather/pest interaction, and influence of weather on pest management decisions was presented in formal papers and discussed at length informally. Personnel associated with Statewide IPM Project activities benefited greatly from participation. The conference proceedings will be published in book form by Academic Press. The conference program is given in Appendix III.

EVALUATION OF IPM PROJECT

There is a critical need to evaluate the impact that the Statewide IPM Project and other IPM activities have on the way pest management is conducted in California. A number of approaches to this need can be visualized. One would be the establishment of a baseline period of pesticide use in selected crops and observation of pesticide use over time. This approach has merit, but the change in pesticide use over time has been the result of a number of externalities and complicates analysis. For example, in total pounds applied, there has been an increase in herbicides and a stabilization or decline in insecticide use, which means that specific information on specific pesticides on a given crop or crops would have to be compared for an accurate assessment. A difficultly likely to arise with that method would be obtaining information accurate enough to measure trends over time. CDFA, cooperating with personnel in the University of California, is working on ways to more effectively develop these data.

Another approach is to study in depth the management practices of growers of selected crops who have and have not adopted IPM practices developed and tested by personnel of the IPM Project and their associates in the public and private sector. Grower attitudes, decision making criteria, pesticide use, and yield and profit data could be evaluated. This may be both a more effective and efficient method of evaluating the impact of the program than an across-the-board pesticide use study. However, it is also a study which, to be done effectively, would require considerable effort in personnel, resources, and time.

Special Evaluation Projects: Dr. J. C. Headley, Professor of Agricultural Economics, University of Missouri, is on sabbatical leave at the Davis campus and has support from the EPA and the Statewide IPM Project. He is studying the impact of IPM activities of pest management in alfalfa. Dr. Headley has been interested in the economics of pest management for many years and is one of the few experts nationally in this field.

Dr. Gordon Rowe, Cooperative Extension Agricultural Economist, is investigating the impact of IPM activities of pesticide use in tomatoes, almonds, and other crops. Dr. John Baritelle, USDA Agricultural Economist, stationed at the Riverside campus, is also studying IPM activities in pesticide use as well as one of the oldest pest management cooperatives in California, the Fillmore Citrus Pest Control Cooperative.

Efforts are underway to develop greater contact and cooperation between these economists and other experts in this area and to involve them directly in the IPM Project. In addition, the potential of local grower pest management cooperatives to implement modern pest management programs is being investigated.

APPENDIX I

UC/IPM PROJECT BUDGET PROJECTIONS

A. Current Budget Projections

Estimates of current budget projections for 1980-81 and 1981-82 are summarized as follows:

(Dollars in Thousands)

	1979/80	1980/81		1981/82
		(Estimated)	(Actual)	(Estimated)
Computer System	$ 641	$ 200	$ 260	$ 175
Personnel	175	500	503	550
Supplies and Expenses	58	80	71	80
Grant Funds	251	720	726	755
	$1,125	$ 1,500	$ 1,560	$ 1,560

1. 1980-81. Estimates for 1990-81 included $200,000 for the computer system but unanticipated installation costs plus inflation have increased that to $260,000. Grant funds were projected at $670,000 in the 1980 report but an inflation factor augmentation by the state made it possible to increase grant funds to an estimated $720,000 and $726,000 have been committed. Personnel and Supplies and Expense are close to projections.

2. 1981-82. Estimates for 1981-82 include $175,000 for the computer system which will be dedicated to maintenance of hardware and software and to telecommunications lines. Grant funds, a key element to effective Commodity Work Group function, are projected to rise to $755,000. All personnel will be in place and costs for support are projected to rise to $550,000. Supplies and expenses are projected at $80,000. If the annual inflation rate continues at the present pace, maintenance of program activity may require further funding.

B. Reallocation of Internal Resources

Reallocation of resources from within UC has been approached in two ways:

1. As indicated in the introduction, IPM is a new field of science that requires new expertise to focus applied ecology and systems analysis on the biology of pest management. As

faculty positions become vacant and staffing plans are developed, several of these will involve recruitment for expertise appropriate to the IPM effort. Evaluation of each vacated position and priority for the IPM area will be a continual process and over time, capabilities will be strengthened in this area.

2. Reallocation has also been accomplished through the involvement of faculty and Cooperative Extension personnel in the grants program which has identified data gaps needed to develop a workable pest management system. In these programs the faculty who are working in the component disciplines of entomology, pathology, nematology, weed science, plant genetics, agronomy, etc., have redirected a portion of their research effort directly to the IPM Program.

   For example, in the alfalfa, cotton, grape, and almond research projects funded from the grants program, there are fifty scientists directing a portion of their time and regular state support towards IPM. Based on the percentage of effort of each of these scientists, an estimated 13.0 FTE or $650,000 is directed toward this effort.

C. External IPM Funding

The following compilation provides information on the major sources of extramural funding in the IPM area:

1. EPA/USDA Adkisson Project.

   Title -- Development of Comprehensive, Unified, Economically, and Environmentally Sound Systems of Integrated Pest Management for Major Crops.

   Objectives -- A multi-university consortium focused on cotton, soybeans, apples, and alfalfa. The overall objectives are to enlarge basic knowledge of major managed ecosystems and to use this knowledge in the development of ecologically oriented systems of management that hold pest populations below crop-damaging densities; are less energy dependent, optimize economic returns to producers and society, and cause least damage to the environment.

   The program utilizes systems analysis and modeling as a central unifying and research-guiding tool.

   The linkage of this program with the California program is accomplished through the California Coordinators on the national project: C. Summers, alfalfa; H. Riedl, apples; A. Gutierrez, cotton. In addition, A. Gutierrez, Associate Director of the California program, is Associate Director of the national project.

   Funding -- Fiscal Year 1979 is the first year of a five-year project at $3,000,000 per year nationally. California in 1980-81 has: alfalfa - $123,580; apples - $35,701; cotton - $218,739.

2. NSF -- Gutierrez.

   Dr. Gutierrez, Associate Director UC/IPM Project has an NSF grant for ecosystems development, funded at $95,000 in FY 1980-81. Gutierrez and Nowierski have an NSF grant in FY 1980-81 for $45,000 for walnut pest management.

3. Western Region Coordinating Committee, WRCC-34.

   Title -- Integrated Pest Management for Semi-Arid Dryland and Irrigated Agro-ecosystern in the Western Region.

   Objectives -- A Western Region Coordinating Committee organized in 1979 to prepare position papers on present knowledge, state of the art, and research areas of primary importance to the Western Region in both dryland and irrigated situations. The crops and areas chosen for attention include:

   alfalfa, dryland and irrigated
   small grains, dryland and irrigated
   cotton
   sugarbeets
   corn
   potatoes.

   The objective is to form the written basis for preparing a regional project which would then qualify for USDA Regional Funds if approved. Subcommittees for each commodity have been formed.

   Funding -- Funded for 1980-81 at $45,000 for administration and travel.

4. USDA/SEA Extension -- Smith-Lever Funds.

   Title -- Cooperative Extension's "California Statewide Integrated Pest Management Project."

   Objectives -- The objectives of the California program are:

   a. To systematically collect data on arthropod, disease, nematode, vertebrate, and weed pest populations, predator and parasite populations, and other components of the agricultural operation as a part of the pest management program. The data will be used for developing pest outbreaks and permit a systems approach to pest control.

   b. To help farmers develop better insect and microbial pest management techniques for protecting crops from insects, mites, nematodes, vertebrates, diseases, and weeds while reducing the producer's costs and protecting consumers from increased costs without lowering quality and yields. This will be achieved by demonstrating known integrated pest management techniques.

c. To monitor selected components of the environment in pest management areas sufficiently in order that agricultural practices which may have detrimental effects will be modified or adjusted to meet accepted standards.

d. To keep farmers, farm workers, their families, and the public from possible harmful effects of toxic materials, particularly those used on agricultural crops.

Farm Advisors and Specialists in Cooperative Extension have IPM subprojects which include:

almonds
apples
grapes
alfalfa
walnuts
tomatoes.

The chair of each of these groups is either the chair or a member of the Statewide IPM Program. Funding requests are coordinated amongst the various tasks to be performed.

Funding -- Five-year program for 1978-1982 currently funded for $199,000 and projected to $240,000 for FY 1980-81.

5. EPA, Office of Pesticide Programs.

Title -- Cooperative Agreement with UC for Analyses of Costs and Benefits of the Use of Pesticides.

Objectives:

a. To provide economic analysis of proposed regulatory action on specific problem pesticides (RPARs) on use sites in California and elsewhere in the U.S.

b. To conduct baseline analyses of the benefits and the costs of the control of the economic pests by chemical and nonchemical means on a site without reference to a specific regulatory action pending at EPA.

c. To conduct data gathering and/or information retrieval activities relating to pesticides benefit or economic impact analyses.

The principal investigator is Dr. Gordon Rowe, Agricultural Economist, UC Berkeley.

Funding -- $425,000 for a two-year period, October 1979 to September 1981.

Summary

These five programs total $1,015,520 in extramural support for 1980-81. In addition, there are a number of research grants to individual investigators from various public and private agencies that have a portion of their effort directed towards IPM, but they are not catalogued in this report.
APPENDIX II

COMMODITY WORK GROUP REPORT SUMMARIES

Alfalfa

The Alfalfa Work Group is extremely well organized and is functioning as visualized in the original project plan. Researchers and Extension personnel, led by Commodity Work Group Leader, Entomologist Charles Summers, have critically reviewed the IPM needs in this crop and identified both information and techniques that can be implemented and data gaps that need to be researched. CDFA IPM Unit Specialists have been involved in this process. Research proposals have been solicited and funded and progress critically reviewed. The true intercampus, interdisciplinary nature of the prioritization, funding, and review is remarkable in this group for its integrity and effectiveness.

The computerized Egyptian alfalfa weevil decision model, previously field tested in the Fresno area, is now being field tested throughout the State and appropriately modified for widescale use. Additionally, useful findings have been made relative to the importance of rodent damage in alfalfa, economic losses caused by certain foliar diseases and sources of resistance, and weed/insect interactions affecting stand longevity. A potentially important contribution to the knowledge of alfalfa physiology, an alfalfa growth/pest interaction model, is being cooperatively developed by a team of physiologists, agronomists, and workers in the pest control disciplines.

Core staff analysts Ted Wilson and Bob Nowierski are working closely with other members of the Alfalfa Work Group in data analysis and other technical matters. The alfalfa group has devoted a great deal of energy to the production of the Alfalfa IPM Manual, taking an active part in its preparation and review. A new Alfalfa Commodity Group Leader, Plant Pathologist Dave Gilchrist, was appointed in October, 1980 to take over from Charles Summers, who is assuming leadership for tomatoes.

Cotton

The Cotton Work Group under the leadership of former Extension Cotton Specialist Kamal El-Zik has organized effectively, reviewed the state of the art, identified areas needing additional research, and called for, reviewed, and funded research proposals directed at data gaps. Dr. EI-Zik has left California to join Texas A&M University as professor of agronomy and plant breeding, and Associate Director A. P. Gutierrez has taken interim leadership of the Cotton Work Group until the new leader, Plant Pathologist James DeVay, can assume leadership.

The major cotton management problems in the Central Valley are the control of Verticillium wilt and lygus bugs and irrigation management. In Southern California the pink bollworm and associated induced pests (e.g., the tobacco budworm) as well as irrigation management are the major concerns. Major efforts are underway to refine and field test the decision criteria for action for lygus bug, pink bollworm, tobacco budworm, and mites in various areas of the state. Data are also being collected to demonstrate the safety, efficacy, and usefulness of, insect viruses for the suppression of armyworms and loopers in cotton. This year a substantial amount of time has been spent investigating the impact of water management and plant density on Verticillium wilt and on developing water management practices which will be compatible with the goals of IPM. Cotton plant growth models are being further refined and cotton growth response to a number of stress factors, especially poor irrigation practices, disease, and insects, is being integrated. These models are currently being or are soon to be field tested around the State. Resources from both inside and outside the IPM Project are being utilized in many of these research and implementation areas. Core Group member Ted Wilson has been working closely with the Cotton Work Group.

Because a significant portion of this year's cotton crop is not yet harvested, no research conclusions are available at this time.

Grapes

Projects funded through the Grape Work Group provide excellent examples of interdisciplinary cooperation. The group is chaired by Riverside Nematologist Howard Ferris. A comprehensive approach to the management of pests is achieved by making the grape plant the central focus of the management system. Weather, fertilizer, irrigation, cultural practices, and other factors are then shared to see how they affect the way pests interact, how pests and their natural enemies relate one to another, and the plant's response to pest damage. Two projects funded by the IPM Project serve to bring all the activities together. One has been the refinement of a basic crop growth model with the addition of further information on root growth characteristics and field data collected over six years. The other is a series of experiments examining the impact of a variety of vineyard cultural management practices, including weed control. In these experiments, viticulturalists are producing data on vine growth and fruit production and quality while, at the same time, plant pathologists, entomologists, and nematologists are collecting information on pest populations in the same vineyards.

Preliminary results from the vineyard culture experiments indicate a number of interesting trends. Incidence of powdery mildew has been shown to be significantly affected by cultivar, frequent irrigation, and addition of nitrogen fertilizer, but not by a number of other cultural practices. The environmental conditions of 1980 were not conducive to bunch rot development and therefore effects of cultural treatments on this second disease could not be measured. However, a separate project on microclimate, also funded through IPM Project, has shown a relationship of bunch rot occurrence to trellising type. The nematode studies have produced some interesting preliminary results on the impact of natural enemies in the experimental vineyards. In greenhouse tests, one fungus has been shown to reduce galling by root-knot nematodes in tomatoes. Information was also gathered on insect distributions in the test vineyards and on varietal susceptibility to mites. Although some problems in experimental design have become apparent during the first year of these cooperative projects and must be solved, the experiments are providing pest biologists with

heretofore unavailable data on vine and fruit growth characteristics to allow a much more comprehensive analysis and verification of pest effects.

A related project has been undertaken to investigate the effects of vineyard cultural management on the microclimate (including wind, solar radiation, temperature, and relative humidity) experienced by pests in the vineyard. For instance, when vine canopies are dense, the temperature at the plant surface tends to be lower than the ambient air temperature and higher when the canopy is light.

A number of other projects, separate from the plant growth model and the cultural practice experiments, have also been yielding results. A project has begun which seeks to prolong vineyard productivity by inarching or bud grafting nematode tolerant rootstocks to established vines. Studies are being undertaken to explore the potential of anthelminthic drugs for the control of nematodes. In the area of insect pest management, distribution patterns have been determined and sampling methods devised for the omnivorous leafroller and economic thresholds are being analyzed for the orange tortrix. The roles of coyote bush in providing habitat for orange tortrix natural enemies and blackberry bushes as overwintering sites for a parasite of the grape leafhopper are also being explored. Studies on the ecology of spider mites are expected to lead to information which will allow more selective use of pesticides in the vineyard and avoidance of spider mite outbreaks. Information on vertebrate pests has been obtained through a series of interviews of growers. Information on unexpected relationships between rabbits and rodents and various aspects of grape culture has been gathered and further observations made on the relationship of adjacent fields to vertebrate populations. A basic model for the population biology of California ground squirrels has been completed.

Almonds

The Almond Commodity Group is chaired by Dr. Martin Barnes, Riverside campus. Research priorities have been established and are listed below. One project has been funded beginning October, 1980. This study involves the selective management of navel orangeworm and mites.

Research Priorities Established for Almonds

I. Management model for integrated pest management on almond orchards.

   A. A mathematical decision model based on feasible alternatives; useful also for designating where additional data are needed.

II. Plant parameters related to IPM.

   A. Growth, development, and production model in multi-variety almond orchards.

      1. Environmental responses.

      2. Pest and pathogen resistance.

      3. Observational varietal plantings established in four major growing areas.

B. Pest damage thresholds.

1. Relationships between population density and damage by navel orangeworm.

2. Relationship between (Tetranychus sp.) mite/days/leaf and photosynthesis, transpiration, growth and yield of almond trees.

C. Long-term effects of herbicides on growth and yield of almonds.

1. Tillage vs. strip tillage vs. chemical non-tillage; mowing vs. chemical non-tillage.

III. Cultural pest management.

A. Removal of mummy resources of navel orangeworm in winter (needs quantification as proposed under I.B.I.).

B. Early harvest.

1. Relationship to navel orangeworm management well established. Study of almond quality/harvest and post-harvest parameters underway.

C. Comparison of mixed legume cover crop vs. volunteer cover crop in relation to mite pests and their natural enemies.

D. Weed tillage, see I.C.1.

IV. Biological pest management.

A. Field release of six navel orangeworm parasites from Texas, Uruguay, and Argentina.

B. Introduction of Stethorus loxtoni an Australian mite predator.

C. Introduction of Amblyseius sp., a predaceous mite from Australia.

D. Use of the parasitic nematode, Neoplectana carpocapsae, for navel orangeworm control.

E. Organisms antagonistic to Aspergillus flavus.

V. Arthropod pest parameters related to IPM.

A. Pheromone monitoring for insect pests.

1. Determination of constituents of female sex pheromone of navel orangeworm, one identified.

2. Peach twig borer pheromone, available.

3. San Jose scale pheromone, available.

B. Damage thresholds, see II.B.

C. Model for population dynamics of navel orangeworm.

1. Quantitative data for use in model, e.g., physiological time; temperature thresholds for flight; fecundity, stage mortality, etc.

D. Integration of chemical and biological control of mites, including establishing insecticide resistant predators, selective use of acaricides.

E. Development of selective and minimal use of insecticides for navel orangeworm.

F. Development of selective acaricides on almond.

G. Pesticide application methods.

VI. Behavioral arthropod pest management.

A. Development of mating disruption by a constituent of the female sex pheromone of the navel orangeworm.

B. Development of mating disruption by a major constituent of the female sex pheromone of the peach twig borer.

VII. Pathogen management.

A. Timing and fungicide selection for Coryneum blight.

B. Hull rot (chiefly Rhizopus stolonifer) epidemiology and insects.

C. Blossom blight (Monilinia laxa and M. fruiticola) control by fungicides.

D. Almond leaf scorch (a bacterial disease) management by surgery, antibiotics; varietal tolerance; epidemiology and insect vectors.

VIII. Vertebrate pest management.

A. Simulation models for ground squirrels, pocket gophers, and meadow mice (funded by UC/IPM).

B. Establish losses of almonds to ground squirrels.

1. Census/feeding habits/damage.

2. Cost/benefit relationships.

Citrus

A Citrus Commodity Group has been established under the chairmanship of Dr. Robert Luck, Riverside campus. The Group's tentative research priorities are being reviewed by the Commodity Advisory Committee. The strategy is to provide a research approach directed at answering both immediate and long-term management questions. There will be a special effort to integrate research and funding from a variety of sources. Tentative priorities fall into three groups and are listed below.

Research Priorities Established for Citrus

I. Develop a leaf /leaf -branch model for citrus (immediate need)

II. Pest assessment.

A. Developing sampling methods to evaluate pest population densities within the canopy and soil/root area of a citrustree (immediate need):

1. California red scale (immediate need).

2. Citrus thrips (immediate need).

3. Citrus nematodes (immediate need).

4. Citrus red mite (less immediate need).

5. Citricola scale (less immediate need).

B. Develop economic injury levels for:

1. Citrus thrips (immediate need).

2. Citrus nematodes (immediate need).

3. Phytophthora (immediate need).

4. California red scale (immediate need).

5. Citrus red mite (less immediate need).

6. Stubborn disease (less immediate need).

7. Citricola scale (less immediate need).

C. Determine the biology and dynamics (less immediate):

1. Citrus thrips.

2. Mycorrhiza.

3. Citrus nematodes -- nematode predator and antagonists.

4. Root diseases and their antagonists.

5. Stubborn disease.

6. Tristeza.

7. Argentine ant.

8. Selected weeds.

III. Associated research (middle- to long-term).

A. Sampling strategies for assessing densities of pest and natural enemy populations.

B. Develop extraction techniques for soil organisms (nematodes, fungi, arthropods).

C. Develop a portable data logging system for acquiring environmental and climate area.

D. Water balance -- irrigation.

E. Fertilization -- plant impact.

F. Cover crop.

G. Frost protection.

H. Competition from weeds: cover crop.

Tomatoes

A Tomato Work Group was developed and initial efforts made to establish priorities. However, because clear goals were not established for the work group the committee did not complete the task of identifying all priorities for research and implementational activities. This, combined with insufficient funding, led to no call for research proposals at this time and no funding of research.

However, ongoing research and implementation of IPM related activities were identified. One priority area is the development of root-knot nematode-resistant canning tomato varieties. This is important because of the cancellation of DBCP.

A very active research and implementation program for insect pests (fruitworm, beet armyworm, pinworm) of fresh market tomatoes is being carried out by researchers on the Riverside campus, and they are coordinating their activities with an entomologist on the Davis campus who has years of experience on pests of processing tomatoes.

Efforts to develop a suitable tomato plant development model have also been initiated.

A new Commodity Group Leader, Charles Summers, was appointed in October, 1980, and it is expected that research proposals will be called for in the next year. A draft for the Tomato IPM Manual is well underway and is being reviewed by Commodity Group members.

APPENDIX III

ROLE OF BIOMETEOROLOGY IN INTEGRATED PEST MANAGEMENT
July 15 to 17, 1980
University of California, Davis
126 Wellman Hall

Tuesday, July 15, 1980

Introductory Remarks
Ivan J. Thomason - Director, Integrated Pest Management, J. L. Hatfield - University of California, Davis

Energy Balance of Plant Canopies
R. E. Carlson - Iowa State University

Wind Movement Within Canopies
R. H. Shaw - University of California, Davis

Instrumentation and Techniques for Microclimate Measurements
P. Doraiswamy - Lockheed Corporation

Simulation of Microclimates
J. M. Norman - University of Nebraska

Remote Sensing of Microclimatic Stress
P. J. Pinter, Jr. - U.S. Water Conservation Lab USDA SEA-AR

Modification of Microclimates Via Management

J. L. Hatfield - University of California, Davis

Wednesday, July 16, 1980

Microclimate and Insect Response - Overview
J. L. Stimac - University of Florida

Insect Movement in the Atmosphere
R. Stinner - North Carolina State University

Development of Insect Models for IPM Decisions
A. P. Gutierrez - University of California, Berkeley

Integrated Pest Management Decisions Based on Microclimatic Data
S. Welch - Kansas State University

Nocturnal Activity of Insects
P. D. Lingren - U.S. Cotton Research Laboratory USDA SEA-AR

The Overall Approach to Insect Problems in Agriculture
C. B. Huffaker - University of California, Berkeley

Microclimate and Plant Disease
S. P. Pennypacker - Pennsylvania State University

Soil -Plant-Water Relations and Disease
J. W. Duniway - University of California, Davis

Thursday, July 17, 1980

Radiation Quality and Plant Disease
C. M. Leach - Oregon State University

Modification of the Plant Canopy and Impacts on Plant Disease
J. Rotem - Ministry of Agriculture, Israel

Role of Light and Temperature on Crop/Weed Growth and Competition
D. J. Patterson - Southern Weed Science Laboratory USDA SEA-AR

Microhabitat Variations in Relation to Weed Seed Germination and Emergence
J. A. Young and R. Evans - USDA SEA-AR Reno, Nevada

Utilizing Meteorological Data for Modeling Crop and Weed Growth
J. L. Anderson - Utah State University

Interactions Between Weeds and Other Pests in Agricultural Systems

R. F. Norris - University of California, Davis

Influence of Stress on the Productivity of Weeds and Trees in the Forest Ecosystem S. R. Radosevich - University of California, Davis

Concluding Remarks
J. L. Hatfield - University of California, Davis

APPENDIX VII

March 1982

Report of the UC IPM Project Evaluation Committee

BACKGROUND

The UC IPM Project Evaluation Committee was established in March 1982 by UC Vice President Kendrick to evaluate the progress of the UC Statewide IPM Project. The goal of the committee was to review the overall operations, communications, administrative structure, and effectiveness of the Project. The committee was not charged with evaluating research or implementation programs for technical accuracy or validity. Three questions of overriding concern were:

1) How effectively has UC's IPM Project been functioning?
2) What are the program's strengths and weaknesses?
3) What needs to be done to improve the program?

The Evaluation Committee's membership was divided into three subcommittees charged with assessing different aspects of the Project's operation. The subcommittees and their membership were as follows:

Subcommittee on Coordination and Administrative Structures

Hal Reynolds, UC Riverside, Chairperson
John Anderson, UC Berkeley
Bill Hambleton, Fresno County
Larry Rappaport, UC Davis

Subcommittee on Program and Budget

Don Dahlsten, UC Berkeley, Chairperson
Seymour Van Gundy, UC Riverside
Jim DeVay, UC Davis

Subcommittee on Usefulness (Delivery Systems)

Nick Toscano, Coop. Ext. UC Riverside, Chairperson
Warren Johnson, UC Davis
Cal Qualset, UC Davis

Evaluating an interdisciplinary program of the magnitude of the UC Statewide IPM Project is a difficult task. The evaluation undertaken was, by necessity, of a general nature. The committee used a statement (Appendix I) prepared by former Project Director, Ivan Thomason, on the rationale and concepts behind the Project as a guideline for evaluation.

The following report is a summary of more extensive evaluations made by each of the subcommittees.

1) ADMINISTRATIVE STRUCTURE

The administrative structure of the UC Statewide IPM Project consists of a director, associate director, and Technical Committee and project staff, including a director of the IPM Manual Group, a computer system coordinator, and a Cooperative Extension IPM specialist/coordinator.

The director has overall responsibility for the Project and reports to the director of the Experiment Station. The IPM project director works with the Council of Deans/Associate Directors, director of Cooperative Extension, director of the AES, and the vice president for the Division of Agricultural Sciences in developing operational policy, direction, budget and general goals and objectives of the Project. The director, in consultation with the associate director for science and technology and the chair of the Technical Committee, makes final decision on budgetary allocations with the Project.

The associate director for science and technology has primary responsibility for working with the various commodity work groups to ensure the funded research focuses on the priority problems, is designed and analyzed to obtain generally useful results, has a plan for implementation, and is linked to other projects and disciplines within the commodity and across commodities. The chair of the Technical Committee shares this responsibility with the associate director and oversees the process of identifying research problems and priorities, developing proposals, and reviewing and evaluating accomplishments in regard to stated goals.

The Technical Committee includes the chairs of each of the commodity work groups as well as representatives from the California Department of Food and Agriculture, Cooperative Extension and selected disciplinary areas. This committee reviews the priorities, proposals, reports and accomplishments of each commodity work group as well as the cross-commodity projects and makes recommendations to the chair, associate director and director for funding.

Strengths

The overall administrative structure, which includes each of the components described above, constitutes a peer review and evaluation system that fosters excellence in the research and implementation of the IPM Project. The Project is recognized for assembling an interdisciplinary effort that has made significant accomplishments. A major reason for that success is the program's commitment to critical review, evaluation and linkage of the various research and implementation projects.

Weaknesses

The general view expressed on administrative structure was that the overall design was sound, but improvements could be made in communicating with University personnel outside of the Project.

Apparently, some individual scientists and departments are not aware of the formal procedures by which the Technical Committee defines objectives or sets priorities, and these individuals continue to feel left out. Greater effort should be made to establish lines of communication with department chairs and Cooperative Extension program areas.

2) COMMODITY WORK GROUPS

Work groups are organized by commodities to review the status of pest management programs in the respective crops, identify data gaps and needs, solicit and evaluate research proposals, make recommendations to the Technical Committee on funding, and monitor research progress and results. Commodity work groups are the key planning units within the Project. These work groups provide the forum for the interdisciplinary interaction that is both unique and essential in the UC/ IPM Project. Work groups have been functioning in alfalfa, cotton, grapes, almonds, citrus, walnuts, tomatoes and rice.

Strengths

The work group is responsible for identifying research needs and priorities, evaluating research proposals and progress reports, and ensuring that research in that commodity represents a cohesive program with clear linkages. These responsibilities are critical to the success of the Project, but they are difficult and sensitive tasks and require determination and dedication to goals by each scientist involved. The chairs of each of these groups have been responsible for providing the leadership necessary to keep the focus on the process and goals of the Project. Some groups are more experienced and successful than others, but the net result has been a record of accomplishment unparalleled in the country. As long as commodity work groups continue to insist on strict adherence to the objectives, linkages and implementation of the commodity research effort, the Project will remain successful.

Weaknesses

As with other aspects of the Project, inadequate communication or a "perception" of a lack of communication was identified as the primary weaknesses of the commodity work groups. Individual scientists and departments indicated that they had not been contacted by the work groups and therefore had no input into the priority-setting process or access to the Project. It was not clear to everyone how the members of the commodity work groups were chosen, and there was a perception by many that the Project was a "closed" group. While most commodity groups were perceived to be doing an excellent job, some improvement is needed in others to develop a cohesive research and implementation program.

3) ADVISORY COMMITTEE

A Policy Advisory Committee (PAC) was mandated in the initial legislation that provided funding for the Statewide IPM Project. This committee is composed of representatives from a broad group of state and federal agencies, grower organizations, consumer groups, as well as representation from labor and environmental groups. The committee provides a forum for discussion of the project and the general direction, goals and priorities.

Strengths
The PAC as structured has provided a good forum for discussion and presentation of-IPM concepts, research needs and program priorities. It has allowed the Project to outline its goals and report on its operations to a broad representation of non-University groups.

Weaknesses
While the PAC may provide a forum for disseminating information on the Project, the meetings have been very general and represent a "show-and-tell" to what turns out to be, in fact, a rather limited audience. Furthermore, the PAC has not really been asked to provide direct "advice" on policy matters. The meetings have not been large enough nor have they been frequent enough to provide a good information dissemination device, and yet the group is too large to be an effective "policy" advisory committee.

4) IPM SPECIALIST/COORDINATOR and AREA IPM SPECIALISTS

A major function of the Statewide IPM Project is getting information about integrated pest management out in the field for farm advisors, growers and pest control advisors to use. The seven county-based area IPM specialists and the IPM specialist/coordinator play a key role in providing this information to the users. They employ a variety of methods and tools including the computer system, IPM manuals, newsletters, mass media, local meetings and workshops to achieve their goals. The area IPM specialists serve as a resource for farm advisors and conduct training schools to facilitate this process. By working through the commodity and disciplinary farm advisors, the new IPM strategies can be effectively moved to a broad audience of users. Area IPM specialists are also involved in many projects to validate research results and demonstrate programs in addition to their educational programs. (Appendices II, III, IV, V, and VI include job descriptions and detailed information on responsibilities of these specialists).

Strengths
The general consensus was that the area IPM specialists have done an incredibly efficient job of implementing IPM concepts in some crops in a short time. The area IPM specialist provides a vital link between research, development, and implementation of IPM programs. They also can play key roles in identifying problems at the field level and providing technical advice on manual preparation. The area IPM specialists have also had most of the responsibility for assisting county staff in learning to use the IPM program's computer system.

Weaknesses
The primary concern expressed regarding the area IPM specialists is a worry that they may be intruding on the traditional role of the disciplinary Cooperative Extension specialist. Much progress has been made in overcoming similar fears of farm advisors as experience has been gained on both sides and programs begin to evolve that demonstrate the value of the specialists. However, there is still a concern expressed that the area IPM specialists need to be constantly sensitive to their role with respect to other Cooperative Extension personnel. Another fear is that the area IPM specialists will represent competition for grant monies normally channeled toward the campus-based disciplinary specialists. Again, increased cooperation and communication between these two groups was seen as a way to alleviate most of these problems.

There was also some concern that the area IPM specialists were primarily entomologists with little or no expertise in nematology, plant pathology or weed science, and few active IPM programs outside entomology. Special efforts should be made to establish programs in these areas, especially for weeds. It is also recommended that the Project strengthen its links between researchers and the area IPM specialists. Researchers can learn much from the area IPM specialists since they are in the field on a day-to-day basis, and the area IPM specialist can learn much about new technological developments from researchers. One suggestion was to include one or two area IPM specialists on the Technical Committee and be sure they are well represented on the commodity work group committees.

5) MANUALS

The IPM manuals are a key component of the total implementation effort. They are designed to assist growers and pest control advisors in making decisions in the field with regard to their pest management programs. The manuals have been developed as a series and follow a similar format: a general discussion of crop biology and production practices in relation to pest damage; seasonal monitoring charts and guidelines; and biologies and IPM guidelines for each key pest. The manuals are well illustrated and contain color photos of life stages, damage symptoms, and natural enemies in the discussions of each major pest.

A centralized staff produces the manuals with a director and several staff writers. Jack Clark, Cooperative Extension Photographer, has been responsible for photographic content. The approach to producing the manuals has been to have a staff writer prepare a draft in consultation with the various disciplinary scientists, and then revise it after a comprehensive review. To date, manuals have been published on alfalfa hay, walnuts and tomatoes, with those on rice and citrus in various stages of completion and manuscripts on almonds, cotton and cole crops/lettuce underway.

Strengths

The approach to developing the manuals has resulted in an "integrated" publication with a style and format directed toward the grower and PCA as the user. The manuals present the best, collective, state-of-the-art information on integrated pest management for that particular crop. General comments indicated the manuals represented a highly professional, usable publication that not only provided an extremely useful tool for the growers and PCAs, but also were extremely valuable teaching references for the farm advisors and area specialists.

The manuals have received considerable praise at the national level and W-161, the Western Regional Research Project on IPM has chosen the alfalfa hay manual to be adopted (with some revision) as the regional manual, has provided funds to join in the production of the cotton manual as a regional effort between California, Arizona and New Mexico, and has approached the manuals group to produce an IPM manual on potatoes as a regional effort.

Weaknesses

Concern and disagreement over the approach to the IPM manuals by the Project was expressed in two areas. Experiment Station scientists and some disciplinary Cooperative Extension specialists considered the manuals too "elementary" in content. This concern relates to a second point: some

observers suggested that the manuals should be prepared by having disciplinary scientists, each expert in their field, prepare individual chapters rather than by a staff writer. This view felt the manuals were not as useful as they could be for these reasons.

6) COMPUTER SYSTEM

The computer system became fully operational in 1981-82 and is in its first year of actual use. The network consists of one large central computer in Davis; three smaller "district processors" at Davis, Riverside, and Kearny Horticultural Field Station; 12 terminals in county farm advisors' offices; and several research terminals at the Berkeley, Davis, and Riverside campuses. The system is currently designed for education and field-testing within Cooperative Extension and for field-testing and support of research sponsored by the Project. A detailed description of the system can be found in Appendix XX.

Strengths
It is generally recognized that the computer network design is excellent and that the computer will become increasingly important in implementing IPM program elements and in enhancing communications between the county-based farm advisors, area IPM specialists, campus-based disciplinary specialists and growers and PCAs. The weather and day-degree software is already being used to predict the appearance of pests and crop development in the field. Over the long term, demonstrating that the computer can be used in a functional and useful manner will be a major contribution to the development of IPM programs throughout the country.

Weaknesses
Since the system is in its first year of operation at the county level, it is premature to provide any definitive evaluation of its total utility. However, it is clear there is need to develop useful software covering a wide variety of programs. More experience will need to be gained with current software and programming to determine the system's ultimate value. It still remains to be seen whether all types of data, all predictive models, or the statistical packages lend themselves to common usage.

Attention will also have to be given to evaluate the design of the system with regard to new developments in microprocessor hardware. As more equipment and trained personnel become available, the system may have to change to maintain maximum flexibility and efficiency.

7) BUDGET

A detailed budget breakdown is given in Appendix XXI. Analysis of the budget for the past three years in terms of percent of total devoted to each activity shows that 53-63% of the total budget has been devoted toward fixed costs with the computer system budget stabilizing around 20% and the Cooperative Extension implementation group having slowly risen to about 25%. From 36 to 46% of the total budget has been allocated to research.

In the first two years of the Project a sizeable proportion of the budget was allocated to acquisition and installation of the computer network. Subsequent budgets reflect the costs of maintaining the system, which will be substantially less (on an annual basis) than the initial cost. Minimally, the facility requires service contracts, communication costs as well as the facility and systems personnel

to operate and maintain the system software. The subcommittee on budget review considered that the budget correctly reflects the need to allow the network to develop its full operational mode.

The amount of the fixed costs allocated to the Cooperative Extension implementation group appeared to the subcommittee to be justified since the specialists were key to implementation of the program - "there would be very little need of a program if there were no implementation." At the same time, the subcommittee considered the 36% figure allocated for research was on the low side and perhaps something approaching 40 to 45% of the budget should go for research.

Strengths

The general consensus of the subcommittee evaluating the budget was that the Project had done an extremely efficient job of allocating funding and that the state received maximum return for the dollars invested. The process developed to set priorities and to review and fund research on-an annual basis had maximized the scientific value of each dollar spent.

Weaknesses

Some commentators expressed a general concern that a disproportionate share of the budget has been spent on the computer system and that more budget should be directed toward bringing together state-of-the-art technology and getting it into manual form. The manuals were perceived to have much more to contribute toward building a positive image than the computers and should be given a relatively high priority. Others felt more of the budget allocated to the computer system should have been directed toward research.

8) COMMUNICATIONS

The success of any endeavor will ultimately be judged by how well the information or process is communicated throughout the system. A subcommittee was given the charge to explore communication between the IPM Project and external audiences, within and outside of the University. General findings and perceptions are presented below.

Strengths

One of the most important accomplishments of the Project is increased communication and cooperation among a diverse group of disciplinary scientists. A number of scientists have been attracted together to focus on problems that would not have otherwise been identified or studied by an interdisciplinary team. The Project has brought the three major UC agricultural campuses closer together. At the same time, it has brought together scientists in different departments on the three campuses. The subcommittee sees this as a major contribution of the Project and one, which will have ramifications in the future with respect to the solution of difficult pest management problems in the various commodities.

The IPM Project appears to have established satisfactory to excellent working relationships with a wide group of external groups including WACA, CAPCA, California Agrarian Action Committee, the USDA, National Weather Service, State Resources Agency and a number of the commodity groups.

Weaknesses

A number of Experiment Station and Cooperative Extension personnel throughout the state were queried about communications with the UC/IPM Project. Some expressed concern about the structure and administration of the UC/IPM program. Most of these individuals thought it tended to circumvent established bureaucratic channels. The concern was based upon the fact that the program functions as a small, but essentially parallel, unit within a large experiment station. Some individuals interviewed expressed the view that the UC/IPM Project should be incorporated into the existing system, as communication from Technical Committee to commodity committee to participant represents a considerable degree of independence from existing structures with the Experiment Station and Cooperative Extension. This viewpoint existed most strongly in some of the disciplinary departments, and particularly among chairmen, but it also includes county directors. There also was confusion between the Experiment Station IPM project and the Cooperative Extension IPM project.

The above problems may only be resolved with time, and resolution will depend a good deal upon success of the program. It is clear, however, that a lack of communication exists and that misunderstandings have resulted. For example, some department chairmen believe faculty involved in the program are not working within departmental purview, and they feel poorly informed about the UC/IPM effort. A few see the program as an infringement on traditional farm advisor responsibilities in counties.

It seems evident that the UC/IPM project needs to implement stronger linking and communicating within established channels. Otherwise, a general lack of information will continue to result in misunderstanding and possibly resentment. One way to improve communication would be for the IPM Newsletter (now distributed only to Extension offices) to be sent to associate deans for research and to department chairmen for information and circulation to interested, although not necessarily involved, staff. In fact, a number of UC personnel are confused about the IPM staff descriptions, responsibilities, and functions. In various reports one reads such terminology as: IPM Project staff; IPM Project administration; IPM core staff; IPM implementation staff; IPM Technical Committee and IPM commodity groups. It is not surprising that there is some degree of confusion. An explanation of the present organization could be the principal content of a future Newsletter having an expanded circulation.

General concern was expressed over an apparent lack of communication and coordination between the UC Statewide IPM Project and the activities of the IPM Unit with CDFA. Their production of IPM manuals and educational material seems to confirm this concern.

9) GENERAL CONCLUSIONS AND RECOMMENDATIONS

As a general conclusion the Review and Evaluation Committee found the UC Statewide IPM Project has been highly successful in bringing together a large number of scientists from a broad range of disciplines to focus on the complex interactions of crop and pest management. Opinion was expressed that the State of California and the University can be particularly proud that the program has achieved such success in a relatively short period of time.

As with any project of this magnitude, there is a need for constant evaluation and adjustments to keep a focus on the primary objectives and to make improvements where needed. The major area of

concern revolves around the issue of "communication" and the following specific recommendations should be considered:

1) Increase use of established Experiment Station and Cooperative Extension lines to inform departments and their chairs, program directors, campus-based disciplinary specialists and county-based farm advisors of the procedures, priorities and progress of the Project.

2) Involve the above lines of communication within the Experiment Station and Cooperative Extension to provide greater input in establishing research priorities and in developing proposals.

3) Involve area IPM specialists more closely within the commodity work groups of the Project and be sure they have representation on the Technical Committee.

4) Encourage greater interaction between the campus-based disciplinary Cooperative Extension specialists and the IPM Project so that there is a better linkage among all of the disciplines involved.

5) Provide for greater interaction between those involved in the IPM commodity work groups and the various marketing order/industry funded commodity groups. This would ensure more efficient use of the collective funds available for research on the various commodities.

APPENDIX VIII

1994 *Ad Hoc* IPM Research Program Review—Letters

Follow-up letter sent to:
Ad Hoc IPM Research Program Advisory Committee
Regarding: October 27, 1994 Meeting

Ad Hoc IPM Research Program Advisory Committee (Participants)

Name	Representing
James Wells	California Department of Pesticide Regulation
Robert Peyton	UC Division of Agriculture and Natural Resources
John McLaughlin	Cotton Research Lab
Judy Stewart-Leslie	Association of Applied Insect Ecologists
Kim Crum	CAPCA
Jack Orr	CAPCA
Jim Durst	California Farm Bureau Federation
Steve Balling	Del Monte Foods
Mark Chandler	Lodi-Woodbridge Winegrape Commission
Gary Obenauf	Prune Advisory Board
Denise Ward	Cling Peach Advisory Board
Paul Walgenbach	Western Agricultural Chemicals Association
Richard Reed	Community Alliance with the Family Farmers Foundation
Jake Blehm	Buena Biosystems/ Biological Control Producers
Eric Vink	American Farmland Trust
Mary O'Donnell	EPA, Pesticides and Toxics, Region 9
Steve Shaffer	CDFA
Mike Fitzner	USDA-ES IPM
Gregory House	CCOF
Chuck Rivara	California Tomato Research Institute

Ad Hoc IPM Research Program Advisory Committee (Non-Participants)

Paul Buxman	California Clean Growers
Fran Packard	League of Women Voters
Ted Batkin	Citrus Research Board
Jennifer Curtis	Natural Resources Defense Council
Ed Beckman	California Tomato Board
Gary McIntyre	CSRS Western Regional IPM Program
Peter Cooey	Assembly Agriculture Committee

cc: Technical Committee

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STATEWIDE INTEGRATED PEST
MANAGEMENT PROJECT
(916) 752-8350
FAX: (916) 752-6004

DAVIS, CALIFORNIA 95616-8621

November 10, 1994

Robert Peyton
UC DANR

Dear Robert:

Thank you for attending the meeting of our Ad Hoc IPM Research Program Advisory Committee, and for participating in the process of identifying the IPM Project's research priorities for the five-year period beginning in FY1995-96.

At the meeting, we reviewed the history and current status of the IPM Project, especially the research grants program. Priority IPM research areas for the next five years were discussed in breakout sessions, and facilitators for the breakout groups reported on potential research areas identified. The general consensus was that we should continue to focus efforts in our five current research areas (applied field ecology, biological controls, biorational use of chemicals and biotic agents, cultural controls, and decision support), but we should also explore the possibility of developing a "directed research" category where projects would address specific problems identified by growers, PCAs, agencies or other clientele groups. It was felt that other important general research areas identified (such as weed management, postharvest pests, urban/landscape pests, etc.) could probably be addressed through the current structure, but that their relative importance should somehow be considered in the Request for Proposals.

In the afternoon, we had a general discussion of these priority areas. All breakout groups reported that there was no need for a new category for directed research, but that specific needs identified by growers, PCAs, and others be used in prioritizing projects to be funded. It was recommended that a mechanism be established such that growers and others could provide this input to the IPM Project. Further, the breakout groups assigned relative rankings to the additional general research areas, identifying weed management and postharvest pests as the most significant areas that should receive more emphasis. Resistance management, economic and environmental evaluation, and roadside weed control were rated lowest of the priority areas identified in the morning breakouts.

As a result of the ad hoc committee's recommendations, we will report on the meeting to the UC Division of Agriculture and Natural Resources (DANR) and note your concerns that additional pest management research emphasis is needed in the areas of weed (vegetation) management and postharvest pests. We will also emphasize this in our Request for Proposals to ensure an

understanding that research proposals in these areas are both appropriate and welcome. Because the number of UC researchers working in these areas limits the number of grant requests we receive, we will recommend that DANR consider additional staffing for the study of both weed management and postharvest pests.

We also wish to act on the ad hoc committee's recommendation that a process for soliciting research priorities from growers and other clientele be developed. Our Technical Committee met the next day d agreed that it is desirable to institute such a mechanism, and we would appreciate your assistance in developing both the process and the information. The approach we propose is to solicit from commodity groups and other interested organizations a list of priority concerns for pest management research and the reasons for the concerns. Our intent would be to obtain meaningful input from individual growers, PCAs, etc., but we would work through organizations such as yours, having you solicit that input from the individuals you represent, prioritize the concerns, and submit the information to us. Attached for your review and comment is a draft form that could be used to obtain the information in a consistent format.

We propose that the responses be collated and developed into a comprehensive publication that could be used in our research program as we evaluate proposals. Because we view this effort as having value beyond the IPM Project, we would provide the publication to all pest management scientists in DANR to make them aware of the research needs that have been identified. We feel that the information would need to be updated regularly, perhaps every two or three years. To ensure that the process would be a useful one, we would like to invite a subgroup of the Ad Hoc IPM Research Program Advisory Committee to meet with us to review this proposal and recommend an implementation plan.

At this stage we would appreciate your comments on how well this approach addresses the ad hoc committee's desire for providing direction in identifying pest management research priorities. We would also like to identify individuals who would be willing to participate in the subgroup to help us solidify our plans. If you have comments on the approach or are interested in participating in the subgroup, please let either of us know.

Again, we feel that the ad hoc committee's discussion and recommendations were valuable, and we appreciate your participation as we design our research program for the next five years.

Sincerely,

Frank Zalom

Frank G. Zalom
Director

Philip A. Roberts (sr)

Philip A. Roberts
Associate Director for Research

FGZ/PR/sr
Enclosure
cc: Technical Committee

APPENDIX IX

January 10, 2001

A Review:
Statewide Special Programs and Projects
in the Pest Management Area

UNIVERSITY OF CALIFORNIA

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OFFICE OF THE VICE PRESIDENT –
AGRICULTURE AND NATURAL RESOURCES

OFFICE OF THE PRESIDENT
Division of Agriculture and Natural Resources
1111 Franklin Street, 6th Floor
Oakland, California 94607-5200

July 7, 2000

DIRECTOR FRANK ZALOM
Integrated Pest Management

Dear Frank:

I have asked Professor (formally Assistant Director) Jim Lyons to conduct a review of all of the SSPPs whose programs focus on pest management. The units that will be the subject of this review include:

1. Integrated Pest Management Program
2. Center for Pest Management Research and Extension
3. The Pesticide Impact Assessment Program (PIAP)
4. The Pesticide Information and Coordination Program
5. The Sustainable Agriculture Research and Extension Program

This review will correspond to the five year reviews of SSPPs normally conducted by *ad hoc* Committees. In addition to assessing the organizational structure and effectiveness, the programs and the productivity of each of the above units, I have asked Jim to make recommendations as to how we should organize our pest management programs to be most effective in the future. I have appended a copy of the charge, which I have given to Jim.

I ask that you cooperate fully with Jim, and provide him with any materials that he may find useful. I also ask that you make time available to consult with Jim, as he may require, and at his convenience. Thanks in advance for your cooperation and help with this important matter.

Sincerely,

Henry J. Vaux, Jr.
Associate Vice President

c: Assistant Vice President Lund
Program Leader Morse

STATEWIDE SPECIAL PROGRAMS and PROJECTS in the PEST MANAGEMENT AREA

A REVIEW

January 10, 2001

James M Lyons
Assistant to the Director

[Page numbers refer to original document]

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STATEWIDE SPECIAL PROGRAMS AND PROJECTS IN THE PEST MANAGEMENT AREA

OVERALL COORDINATION

Assuming implementation of the recommendations presented in the review that follows, Figure 1 presents a schematic of the proposed overall coordination of the Statewide Special Programs and Centers. As described in detail in the text, the Directors of the IPM Program, the Mosquito Research Program, the Center for Invasive Species Research (CISR), and the proposed Center for Biological Control Research (CBCR) would form a "DANR Statewide Special Programs Pest Management Cabinet." This Cabinet would be chaired by the Director of the IPM Program and report programmatically to the Agricultural Policy and Pest Management Program Leader. Additionally, the Directors of the USDA Western Region Pest Management Center (WRPMC), the Sustainable Agriculture Research and Education Program (SAREP), and the Coordinator for the Viticulture Consortium would be members of the Cabinet for coordination purposes.

As proposed here, the Director of USDA's WRPMC will also serve as Assistant to the Director of the IPM Program and assume the role as Pesticide Coordinator for DANR, and to facilitate communication activities with state and federal agencies and various commodity groups.

This proposed "Cabinet" would provide regular input on activities of the statewide special pest management programs to the Program Leader. This level of coordination would assist the Program Leader in carrying out his/her overall responsibilities in the pest management program area. While the Director of SAREP reports programmatically to the Agricultural Productivity Program Leader, by being involved in this Cabinet, the opportunity for coordinating pest management activities of SAREP could be realized.

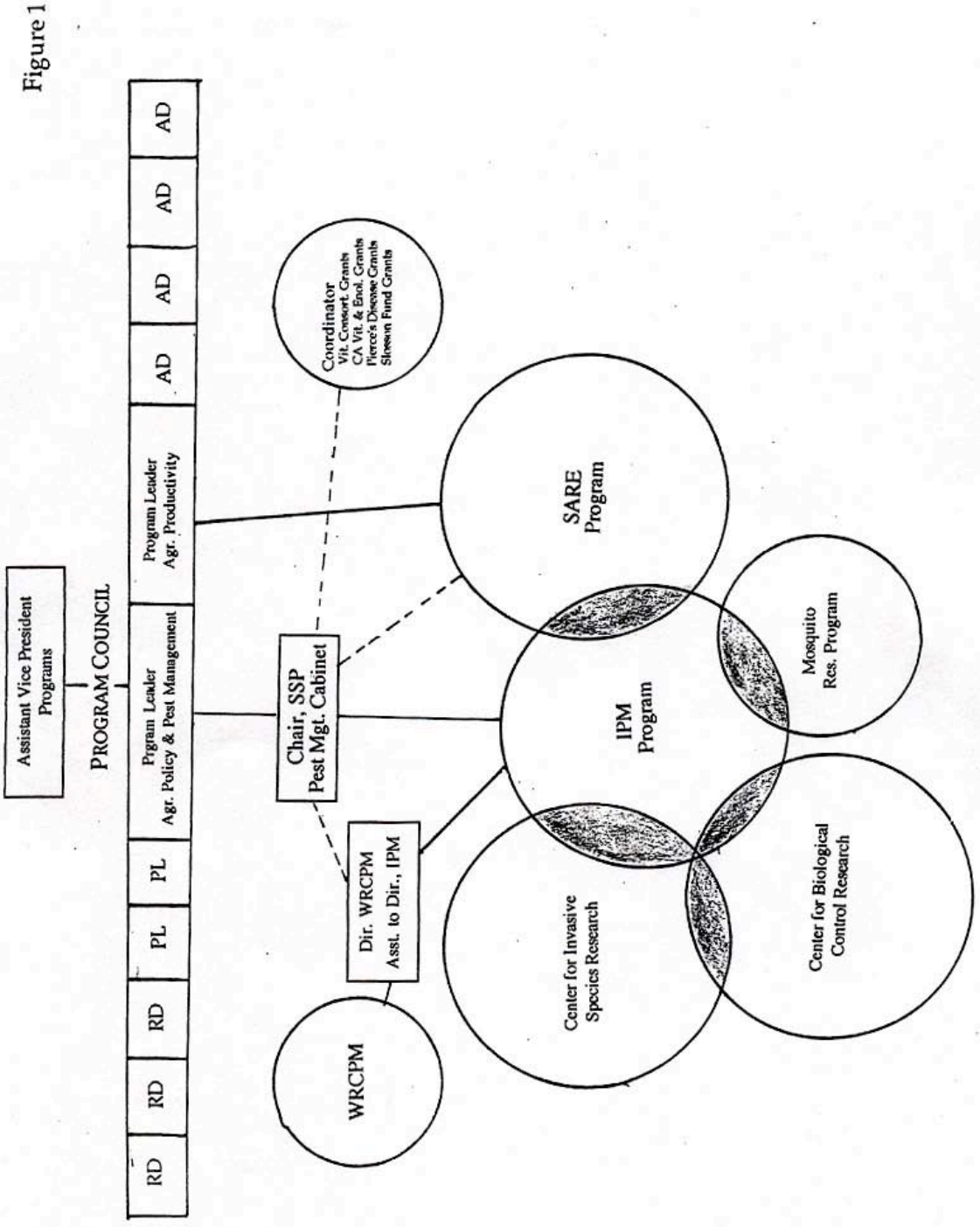
This proposed structure provides a number of unique opportunities for collaboration, cost saving and more efficient service to a broad array of users. Such opportunities include:

- A DANR Pest Management Web site which could tie together pest management sites and present their information through distinctive portals designed for specific user groups;

- The IPM service units could facilitate the Center for Invasive Species Research the Center for Biological Control Research with development of publications, educational programs and other forms of electronic publications. Proposals for printed publications and electronic information dissemination would be developed via consensus of the “Cabinet”;

- Grant programs could be processed through the IPM administrative structure which would allow for coordination of RFP's, avoid duplication among the various grants programs, and provide an online database which would quickly provide access to all of the grants in terms of subject matter, amount of funds, and personnel involved.

Figure 1


Assistant Vice President Programs
PROGRAM COUNCIL
RD
RD
RD
PL
PL
Program Leader Agr. Policy & Pest Management
Program Leader Agr. Productivity
AD
AD
AD
AD
Chair, SSP Pest Mgt. Cabinet
Coordinator
Vit. Consort. Grants
CA Vit. & Epid. Grants
Pierce's Disease Grants
Sloesen Fund Grants
Dir. WRCPM Assi. to Dir., IPM
WRCPM
SARE Program
IPM Program
Mosquito Res. Program
Center for Invasive Species Research
Center for Biological Control Research

THE REVIEW

On July 7, 2000, Associate Vice President Henry Vaux invited me to carry out a review of the Statewide Special Programs and Projects in the pest management area. A series of questions were posed as a guide to describe the scope of the review (Appendix 1). The units to be reviewed included the following:

1. Center for Pest Management Research and Extension (CPMRE)
2. Pesticide Impact Assessment Program (PIAP)
3. Pesticide Information and Coordination Program (OPIC)
4. Integrated Pest Management Program (IPM)
5. Sustainable Agriculture Research and Extension Program (SAREP)

The review was carried out over the past six months by examining reports and documents provided by the units considered in the review, by interviewing and discussing the issues with a broad cross section of individuals from within and without the division, and with those directly involved in the programs and projects reviewed (Appendix II). In addition to the Projects outlined above, the newly proposed Center for Invasive Species Research at UC Riverside and Center for Biological Control at UC Berkeley are also included.

BACKGROUND

As the Division moves into the 21st century, the notion of integrated pest management and sustainability has evolved to the stage where the principles and practices are essentially embedded in the thinking of all division academics, departments and counties as they develop research and extension programs to address Division priorities. So why the need of Statewide Special Programs and Projects? Why do we still need the Statewide IPM Project or the Statewide Sustainable Agriculture Research and Education Program? Why not just take these funds and distribute them across the campuses and regions?

From a historical perspective, it is informative to consider the dynamics in the state legislature that led to creation of statewide special projects and programs. There were two predominant driving forces: 1) funding constraints, and 2) need for a mechanism to foster interdisciplinary, inter campus and regional resources to solve critical applied problems facing California's agriculture and natural resource base.

Funding: Early in the history in of the experiment station and cooperative extension service in California, essentially all of the support came by way of formula funding from the federal government and from a block grant for research from the state. As state funding became constrained in the early 1960's further augmentation of the traditional block grant ceased. Then UC's research budget was specifically singled out for cuts in the late 1960's and it became clear to legislators favoring priority research programs for their constituents, that they could be successful only by targeting budget augmentations earmarked for specific activities. Thus, the beginnings of funding research and extension activities in targeted special programs were established.

Problem solving activities: In the early 1960's modem agricultural research became increasingly more complex and expensive as all the new science and technology that resulted from the large government programs funded at the end of the war came into use. As this evolved it was clear that agricultural research was moving further away from direct application in solving growers' problems than it had been in the 1940's and 50's. It was the perception of the legislature that departmental scientists were focusing on basic research and teaching and not willing to get out into the counties to solve problems. Furthermore, there was little incentive (a.k.a. merits and promotions) for these scientists to join any team effort or cross departmental lines or disciplines to solve problems.

Thus, as a result of these two dynamics, a series of budget initiatives directed at meeting continuing high priority problems related to California's agriculture and natural resources were proposed to the legislature. Hence statewide special projects and programs reporting to the Vice President were established over time, some fourteen all together - starting in the 1960's with Pear Decline Funds, the Wildlands Research Center, Mechanization Research, Control of Starlings and the Mosquito Research Program and ending in the 1980's with the IPM Project, Agricultural Issues Center, Gene Resource Conservation Program and the Sustainable Agriculture Program.

So why the continued need of Statewide Special Programs and Projects? Because the dynamic that led to the formation of these programs and projects in the first place is as important, if not more important, today as when they first came into being, They provide the instrument for the Division to carry out high priority research and implementation activities across departmental lines, across county lines and across disciplines.

I. CPMRE, PIAP, AND OPIC

1. Center for Pest Management Research and Extension (CPMRE)

The Center was established by the University in 1990 as the result of legislative adoption of AB 4161, the "University of California Pest Research Act of 1990."

Currently, CPMRE's mission and responsibilities are stated as follows:

> *Mission:* The Center's mission focuses on reviewing and coordinating pest related research activities conducted throughout the University.
>
> *Responsibilities:* The Center's objectives are to develop and provide information on recommended pest management research priorities that include integrated pest management strategies; biological controls, sustainable agriculture, cultural and mechanical methods and other environmentally sound pest management alternatives.

FINDINGS

In discussions with CDFA and CalEPA DPR it was apparent that knowledge of the CPNIRE was scant, with only a few actually having any interaction with the Center in it's early years when

proposals for quarantine facilities at UC Riverside and UC Davis were developed for state and federal funding. They all agreed that the notion of having some structure where they get access to all of the Division's pest management resources by making one phone call or e-mail would be beneficial. They also saw the need for better coordination of pest management activities within DANR and between DANR and CDFA particularly, using as an example the fact that there were two symposia on the Glassy Winged Sharpshooter scheduled on the same day. Talking with faculty and others within the Division, most had heard of CPMRE but had no knowledge of it's activities except for those that had received a small grant in recent years.

Discussions with CDFA suggested that a mechanism for better communication between the "middle" managers in both agencies should occur. They recognized the value of regular meetings between the Vice President, DANR and Director, CDFA, but additionally the middle managers needed to get together so they could anticipate each other's needs and better coordinate activities. A simple example provided was discussions about membership on various advisory committees.

Because of changes in the administrative environment over the last several years, the mission of CPIVIRE has essentially been superseded. Specifically: 1) adoption of the "New DANR Organizational Structure," December 3,1998; and 2) the success of DANR in competition for locating the Western Region Pest Management Center (WRPMC) on the Davis campus.

Administrative Changes. DANR's new programmatically-based organizational structure established four Program Leaders to provide statewide coordination and leadership for AES and CE academics to plan and conduct programs that address high priority needs within the subject matter of their program areas. Furthermore, establishment of the Program Council, with responsibility for setting priorities and providing recommendations on statewide coordination of resource allocation, supersedes a similar role envisioned for CTMRE but which never occurred. CPMRE was never formally involved in any priority setting or resource allocation process.

Western Region Pest Management Center (WRPMC). Establishment of the WRPMC in the UC Davis Department of Environmental Toxicology provides an additional resource to coordinate pest management activities between DANR and various federal, state and regional agencies as well as industry and commodity groups. For example Goal 3, one of the goals of WRPMC's responsibilities, states:

> "Develop a California program to participate in the Western Region Pest Management Center by establishing a statewide stakeholder advisory committee. This committee will be an integral component of the regional information network, participate in the identification of agro ecological regions in the west, identify the need for and participate in the development of crop profiles/pest management strategic plans, serve as a pool of experts to review technical documents."

In carrying out it's responsibility, the Western Regional Center's advisory committee will have a broad membership including DANR representatives from IPM, SAREP, IR-4, Pesticide Applicator Training, AES and CE pest management experts as well as from commodity groups, Federal and State agencies and the State University system. The WRPMC's 'statewide stakeholder advisory committee' mimics the advisory committee envisioned for the CPMRE

Thus, the mandates of AB 4161 to provide "a means of coordinating and evaluating long-term basic and applied pest research, including the impact of prevention, control, and eradication efforts upon public health and the environment," and to establish "a pest research center which will review and prioritize pest-related research activities conducted through the university," are clearly addressed by the new administrative structures described above and make the CPMRE redundant. Leadership envisaged for the Director of CPMRE is now clearly defined in the new Program Leader for Pest Management and Policy who has responsibility for statewide leadership and coordination of DANR research and extension programs in pest management. Indeed, the Program Leader, under the new DANR structure is imbedded in the resource allocation process with the Program Planning Advisory Committee and the Assistant Vice President, Programs. The Director of the CPMRE was never involved in the resource allocation process in the previous DANR structure. This represented a major weakness in his/her position having any influence in setting research priorities or influencing resource allocation.

Current Director for CPMRE. Mike Stimmann, current director of the Center has expressed, in writing, his intention to retire in the near future. In addition to being Director of CPMRE, Mike also serves as the Statewide Pesticide Coordinator in his role as director of OPIC (see # 3 below). Informal discussions with him led to the fact that he would be interested in considering retirement, effective June 30, 2001, with a contract to be hired back at 49% time. The Division provides a portion of his FTE and $100,000 in grant funds, which have been administered by the Center.

RECOMMENDATIONS

1. Initiate procedures to "mothball" the Center for Pest Management Research and Extension (CPMRE), i.e., recognize that it has become nonfunctional and that the duties and responsibilities envisioned in AB 4161 are now performed by the Agar. Policy and Pest Management (APPM) Program Leader. Continuing any reference to CPMRE] is unnecessary and will only cause confusion, particularly with the extern at clientele and state and federal agencies.

At some time in the future, after it can be clearly demonstrated that the APPM Program Leader, the IPM Program, the new statewide Center for Invasive Species Research and the proposed Center for Biological Control Research are each functioning to carry out the mandates of AB 4161, it may be appropriate to take steps to formally "disestablish" the CPMRE.

2. To facilitate the flow of information and advice on pest management activities, the APPM Program Leader should establish an informal "Cabinet" composed of the Directors of those Statewide Special Programs reporting to him/her (IPM Program, Center for Invasive Species Research, Center for Biological Control Research, Mosquito Research Program). In addition, the Director of SAREP, the Director of USDA's Western Region Pest Management Center, and the Coordinator of the OVP Grants Programs should also be included in this Cabinet for coordinating purposes. It is proposed that this Cabinet be chaired by the Director of the IPM Program.

3. A process should be established for conducting regular meetings -annually, semi-annually—between the "middle management" of DANR and the appropriate state agencies, i.e.,

CDFA and CalEPA DPR. From DANR, these meetings should include the APPM Program Leader, the SSP Pest Management Cabinet and campus Associate Deans.

2. Pesticide Impact Assessment Program (PIAP)

The Pesticide Impact Assessment Program (PIAP), funded by USDA has been eliminated and its activities merged into, and replaced by, the new Western Region Pest Management Center (WRPMC), effective September 15, 2000. Rick Melnicoe, who served as PIAP's Western Regional Coordinator and its State Liaison Representative, has been appointed as Center Director of WRPMC.

3. Pesticide Information and Coordination Program (OPIC)

OPIC's mission and responsibilities are stated as follows:

> *Mission*: OPIC's mission is to: 1) provide DANR with pesticide information and coordination for safe, effective and legal use of pesticides consistent with sound agricultural practices; 2) provide information and education to pesticide users in California; 3) assist the pest management community in maintaining pesticide registrations for as long as necessary and feasible; 4) assist in the development of better and more economical pest management technologies; and 5) advise governmental agencies on the impact of their regulatory programs on UC education and research.
>
> *Responsibilities:* Review published pesticide use recommendations for compliance with current state and federal registrations; advise University administrators, researchers, specialists and farm advisors on matters pertaining to state and federal regulations and University policies governing pesticide use and experimentation; and cooperate with regulatory agencies on matters pertaining to pesticide regulations which may affect the Division of Agriculture and Natural Resources agricultural and public health research.

OPIC's resources include Mike Stimmann, 0.25 FTE, Christine Joshel, 0.75 FTE, and approximately $20,000 in support funds.

FINDINGS

With the notice of intention of Mike Stimmann to retire within the next several years, the question is raised as to what strategy could best replace the necessary function of OPIC upon his retirement. Again with the advent of the Western Region Pest Management Center, and the appointment of Rick Melnicoe as its Director, it would appear to be a unique opportunity to transfer the functions of item 1) of the OPIC *Mission* and the *Responsibilities* as stated above to Rick Melnicoe. He is extremely well qualified to assume these responsibilities as a result of his experience in CDFA and as Western Regional Coordinator for the Pesticide Impact Assessment Program since 1991. Items 2), 3), 4) and 5) of the Mission statement above, are carried out as responsibilities of the IPM Program and the WRPMC.

In addition to his proposed duties as Pesticide Coordinator, it is recommended that he assist the Director of IPM in: 1) providing liaison with CDFA, DPR, Water Resources Control Board and Region IX -EPA and other government and commodity organizations; and 2) linking the Pesticide Policy Training for the counties and campus DANR personnel with the IPM Pesticide Education Program.

RECOMMENDATIONS

1. Initiate procedures to appoint Rick Melnicoe as Pesticide Coordinator for DANR on a 0.25 FTE basis reporting programmatically to the IPM Director. In addition, he would be given the title as Assistant to the Director of IPM for purposes of coordinating WRPMC's activities with DANR. If, at some time in the future, Rick Melnicoe should vacate his position as Director of WRPMC, then this arrangement should be re-evaluated.

2. Initiate procedures to complete Mike Stimmann's retirement as of June 30, 2001 and execute a contract to hire him back on a 49% time. This hire back would be as CE Environmental Toxicology Specialist to conduct research and teaching in environmental toxicology and as an advisor to Rick Melnicoe in facilitating the transfer of OPIC's responsibilities to carry out other duties as a CE Specialist in this subject area. It would be expected that the Department of Environmental Toxicology would continue to supply $5,000 for Mike Stimman's laboratory in lieu of I&R FTE for his teaching responsibility, and he would continue to receive 49% of the standard support as a CE Specialist.

3. Initiate procedures to transfer Christine Joshel (0.75 FTE) and the $20,000 for her support under the supervision of Rick Melnicoe as DANR Pesticide Coordinator.

4. The remaining 0.25 FTE (0.25 to Rick Melnicoe and 0.50 towards Mike Stimmann's 49% hire back) and the $100,000 that has been used for CPMRE grants should be transferred to the Agr. Policy and Pest Management Program Leader to continue the use of these funds in pest management activities. These funds could be used to facilitate development of the Center for Invasive Species Research, the Center for Biological Control Research (see following sections) or other high priority needs in pest management.

This transfer would further support the argument that the mandates of AB 4161 are being carried out within the current administrative structure of DANR.

II. IPM AND SAREP

1. Integrated Pest Management Program (IPM)

Integrated pest management (IPM) is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are

selected and applied in a manner that minimizes risks to human health, beneficial and nontarget organisms, and the environment. The Statewide Special IPM Project was created through a budget augmentation passed in the 1979 legislature in response to an April 9, 1979 proposal from the Division. It subsequently became a 'line item' in the University's budget.

Mission: Under it's mission, the IPNI Project develops and promotes the use of integrated, ecologically sound pest management programs in California to:

- reduce the pesticide load in the environment
- increase the predictability and thereby the effectiveness of pest control techniques
- develop pest control programs that are economically, environmentally, and socially acceptable
- marshal agencies and disciplines into integrated pest management programs
- increase utilization of natural pest controls

FINDINGS

Overall comments regarding the mission and program goals of the IPM Project were uniformly laudatory and a number of strengths and values were recorded.

Comments from Ted Wilson, Professor at Texas A&M (formerly Entomology, UC Davis and associated with the UC IPM Program) perhaps best sum up the perception of the stature of the California Statewide IPM Program:

> "The UC IPM Program remains a nationally recognized leader in IPM research and extension outreach. I am not aware of any other state that has produced manuals of the quality as the UC IPM program. From all appearance, the IPM research program is superior to what is being done in Florida, Texas, Cornell, Washington State, and North Carolina. What makes it superior to Texas is the stronger multi-disciplinary focus."

The strength of the UC program is the result of two things: 1) that of it being a Statewide Special Project specifically organized to build upon and leverage the expertise across the campuses and departments to focus in a multi-disciplinary way to solve problems important to California; and 2) the quality of the personnel in the various units of the IPM Project - research, publications and education, information systems, pesticide education—that work collectively as a team from top to bottom. The result is an exceptionally productive model for programs throughout the US.

Under the overall direction and coordination of Frank Zalorn as Director, the IPM Program carries out its mandate employing several service units, which collectively provide the interdisciplinary and integrated research and implementation programs for effective IPIM practices.

a. Competitive Grants. The Program funds IPM research and implementation projects through two competitive grant programs—the Competitive Research Grants Program and the USDA-ES Smith Lever IPM Implementation Program. The Competitive Research Grants Program generally focuses on applied research projects with a time span of one to three years. These projects are expected to result in techniques or tools that will help growers or other pest management practitioners make better decisions but often don't carry the program directly to the user. Smith-Lever funds on the

other hand are granted to projects designed to promote use of IPM practices by growers, homeowners, or public agencies.

Priorities and recommendations for funding in the Competitive Research Grants Program arise through a process involving five IPM Workgroups that assess data gaps and needs. The general topic areas for the five Workgroups have been reassessed and changed at 5 year intervals by facilitated meetings of ad hoc committees chosen for that purpose. The most recent ad hoc committee was comprised of representatives of more than 20 external 'stakeholder' groups and the IPM Technical Committee. Currently these IPM Workgroups include: Applied Field Ecology, Biological Controls, Biorational Use of Biotic Agents or Chemicals, Cultural Controls, and Decision Support. Administration of this process is overseen by the Associate Director of the IPM Program (currently Mike Rust, Entomology, UC Riverside) who serves as Chair of the Technical Committee composed of the Workgroup Chairs.

All respondents were highly supportive of the process and manner in which the grants program has operated. The only issues that surfaced were: 1) an interest in having the subject matter of the IPM Workgroups reviewed (the last review took place five years ago) and perhaps expanded to other fields or different fields; 2) that consideration should be given to perhaps increase the size of awards for a portion of the grants, that is, have a mix of one or two large projects ($100,000 +) and a number of smaller ($25 - $30,000), and 3) that the time frame be extended to a 3 to 5 year or even 3 to 7 year horizon, while still keeping the focus on results that could be implemented.

b. Area IPM Advisors. IPM Advisors are key to fulfilling the mission and objectives of the Statewide IPM Program by disseminating research-based pest management information. They act as a bridge linking campus-based researchers, other CE advisors and specialists, growers and pest control professionals. Eight IPM advisors (one currently vacant) are located either in county offices or at Kearney Agricultural Center, and each have area or regional responsibilities. Their activities are guided by Pete Goodell, Regional Advisor at Kearney, who is Coordinator for the group. The primary clientele for the Area Advisors are the local advisors and PCA's. They use a variety of research and extension methods in carrying out IPM's mission to develop and deliver IPM information and training as well as in coordinating large research and demonstration projects in their areas and regions.

One item that arose in discussions about the Area IPM Advisors is the long standing debate of 'Advisor vs. Specialist' issue. In this debate, the primary criteria needs to remain as to what is needed by the IPM Program to carry out its mission, and if the mission is field implementation and coordination of projects in their areas, then the Advisor series seems to be the most appropriate. The distinction between IPM Advisors and Farm Advisors stems from the fact that IPM Advisors are resources for other advisors and do not carry out work with grower clientele independent of commodity based county advisors. A number of departmental faculty would like to use these Area Advisors as subject matter specialists, which is understandable. But the answer to that issue is for there to be more subject matter specialists hired in the departments rather than perturb the function of the area advisors to solve that problem.

c. IPM Education and Publications. This unit, headed by Mary Louise Flint, produces publications and other educational materials related to pest management. The staff, primarily professional

writers trained in pest management sciences work closely with IPM advisors, farm advisors, specialists and researchers to develop state-of-the-art education materials that reflect the newest advances in pest management. Major accomplishments include:

- publication of 13 crop specific manuals covering 15 crops;
- publication Pests of the Garden and Small Farm and Pests of Landscape Trees and Shrubs, which provide comprehensive IPM programs for home gardeners and professional landscapers;
- working with the Information Systems unit, production of a CD-ROM, The UC Guide to Solving Garden and Landscape Problems;
- publication of a Natural Enemies Handbook, which provides a comprehensive coverage of biological control for all types of pests;
- working with the Information Systems unit, development of brief, comprehensive pest management guidelines for all kinds of pest situations. These guidelines are written by AES or CE faculty and advisors and then edited and maintained in a strict format by the E&P staff and are UC's official pest management suggestions. These guidelines are distributed through the UCIPIM Web page electronically but also published in a camera-ready format that is distributed as photocopies by county extension offices;
- publication of a highly successful Pest Note series to provide pest management information to urban audiences on more than 80 home, garden and landscape pests. These 4-page publications are accessible through the UC IPM web site and are also photocopied and distributed through CE county offices;
- publication (currently in press) of IPM in Practice: Principles and Methods of Integrated Pest Management, which will serve as the curriculum for pest management instructors within and outside of California. A drafted pool of exam questions derived from this text will be implemented in PCA examinations, This publication was developed in collaboration with CDPR, UC and CSU experts and licensed practitioners in the field.

An essential key function of the IPM Education and Publications unit is to continually revise and keep older manuals and books up to date. New pests are constantly moving into California and new technologies developed for management, detection and monitoring.

These publications are recognized as a standard of excellence across the US and abroad—over 132,000 copies have been sold. The IPM manuals are key components of the pest management extension program, they are used widely by PCA's, they are a primary teaching resource for University students in pest management and the photographs, illustrations and management suggestions developed for these publications are used throughout the UC system in other publications, presentations, and a diverse array educational programs. They are the hallmark of the success of the IPM Program.

d. Information Systems. The unit, headed by Joyce Fox Strand, develops databases and software to assist the University's statewide pest management extension and applied agricultural research programs. The unit has a major focus in development and maintenance of online resources implemented through a robust, accessible Web page. This site includes:

- UC's official guidelines for managing pests in California's major agricultural crops and in the home and landscape:

- A database of thousands of color photographs, which help users accurately, identify pest problems;
- A weather database archiving daily weather data from more than 350 stations representing primary California climatic zones. Data include current reports for about 200 weather stations, and historic information for another 130 climate stations;
- Support to researchers validating crop disease and insect models, through collection of detailed, field specific weather data for specific research programs, delivered through the Web database;
- Interactive programs such as degree-day calculators, insect phenology models linked to the weather database, disease models, and other products of IPM research;
- Collection of models of more than 100 insect and mite pests, beneficial, weeds, plants, and crop diseases.
- Database of summarized California pesticide use data since 1990, used for PIAP assessments, to support research, and as background for proposals;
- Database detailing over 250 IPM research projects funded since 1980;
- The IPM Program's Annual Reports;
- Catalog of UC IPM publications, videos, slide sets, educational programs, and software.

The IPM Web site is the largest repository of pest management information anywhere and is used by growers and PCAs to make decisions and support IPM research. Much of the Division's pest management information, in particular the guidelines, is already delivered through the site. In addition, California PIAP and WRPMC contract with the information systems group for their Web site development and maintenance. Usage is high and growing: accesses to UC IPM Web pages grew by 50% each year, from 97 per month in 1996 to 342,000 per month in 2000.

e. Pesticide Education Program. This unit headed by Patrick O'Connor-Marer, through its workshops and publications, reaches employers and workers throughout the state with important pesticide safety information and provides handlers and fieldworkers with skills and knowledge needed to avoid pesticide related problems. In 1987, the Statewide IPM Program assumed responsibility for the Pesticide Applicator Training Program, a USDA Extension function, and receives Federal Funds for part of this program. Much of this work involves developing and testing new and innovative materials and training programs that can bridge the cultural, language, and educational barriers found in California's diverse agricultural workforce. These training programs and materials include:

- Hands-on workshops. Collaborating with CE advisors and agricultural commissioners staff, conduct full day training for pesticide handlers. PEP coordinates the workshops and trains the volunteer instructors (28 required for each workshop);
- Train-the trainer programs. These programs qualify participants, according to California regulations, to train pesticide handlers and agricultural fieldworkers;
- Pesticide applicator compendium. PEP develops these study guides for those taking DPR's Qualified Applicator Certificate examinations, getting information and review from UC advisors and specialists, industry experts, and regulatory agency personnel
- Private applicator certification study manual. PEP has developed a study manual for growers who are preparing to take the private applicator certification examinations.
- Pesticide-related educational programs for health care providers. PEP has developed and is coordinating an ongoing program of training workshops for health care providers in

California to assist them in recognizing and treating pesticide-related illness and injuries. The faculty for this program is drawn from DPR, the Office of Environmental Health Hazard Assessment, the Department of Health Services and UC Davis.

The Pesticide Education Program is highly respected in its pioneering approach to providing safety information to pesticide handlers and farm workers and in carrying out their program the collaborate with many other UC, state and federal agencies including the: UC Small Farm Program, UC Agricultural Health and Safety Center, UC Davis Center for Environmental Health Sciences, UC Berkeley Center for Occupational and Environmental Health, Agricultural Personnel Management Program, the federal EPA/USDA Certification and Training Assessment Group, the US EPA Worker Protection Workgroup, and the US EPA/ USDA/ Dept. Labor/ US Dept. of Health and Human Services 'Pesticides and National Strategies for 'Health Care Providers" Workgroup.

f. Administration. Under the leadership of Frank Zalom as Director, a talented and efficient staff carry out the administrative duties of the IPM Program. One of the key duties of this staff is to conduct the work involved with the grants program -- the call for proposals, receiving grant proposals, distributing to reviewers, etc, etc. An experienced staff conducts this task in a highly efficient manner. It is anticipated that as the Center for Invasive Species Research and the Center for Biological Control become operational, they can take advantage of the existing experience and process their grants programs through the IPM Administration with minimal additional resources required.

RECOMMENDATIONS

1. Permission should be given to change the name of the Statewide IPM Project to the Statewide IPM Program. Use of the term project (which was employed in the original proposal to the legislature and was appropriate at that time) connotes a short-term specific piece of work. Over time, IPM has developed into a broad program and should be recognized as such. The term Program has been used throughout this review,

2. Since Frank Zalom has formally indicated his desire to step down as Director of the IPM Program and return to Entomology as a CE Specialist and AES Entomologist (in the 'Agronomist Series'), a search for a new Director should commence as soon as possible.

3. The new Director should be advised to initiate procedures to carry out a review of the IPM Workgroup structure (particularly with respect to the addition of the Center for Invasive Species Research and the Center for Biological Control Research brought into the structure) with respect to the subject matter areas, size and duration of the individual grants. When the Workgroup structure was reviewed five years ago it was done through a process employing 'stakeholders,' i.e., state and federal agencies, commodity groups and organizations, etc. It is recommended that at this juncture, with the new Centers involved, the review should probably focus as a DANR internal review.

4. With regard to the issue of "Advisor vs. Specialist" amongst the Area IPM Advisors, it is recommended that they remain in the Advisors Series, as the need for field implementation and coordination is as important as ever. The distinction between IPM Advisors and Farm Advisors

stems from the fact that IPM Advisors are resources for other advisors and do not carry out work with grower clientele independent of commodity based county advisors.

It is also recommended that there should be an increased priority for additional subject matter pest management specialists to be hired into campus departments. The Assistant Vice President, Programs should work with the campus Deans and Associate Deans to encourage this priority in their staffing plans.

5. A DANR Pest Management Web Site should be developed to bring together the Division's pest management Web resources and to help users more readily find the information they need. The Web page would exhibit the DANR logo and present DANR information in unified ways through 11 portal" pages, multiple doorways into specific programs or targeted at particular user groups. To accomplish this recommendation DANR should contract with the IPM Information Systems Group for development the DANR Web site and maintenance.

6. As the new Centers for Invasive Species Research and Biological Control Research become operational it is recommended that: 1) their grants programs be processed by the IPM Administrative Staff, 2) that needed publications and educational materials be coordinated with, and take advantage of, existing expertise in the IPM Education and Publications unit; 3) that development of Web pages and other electronic publications be coordinated with, and take advantage of, existing expertise in the IPM Information systems unit so that standard formats can be developed and be compatible with the DANR Web page; and 4) opportunities for "Joint service" on technical committees between the various units should be explored as an additional method of ensuring coordination and avoidance of duplication. Implementing these arrangements will have a budgetary impact on the IPM Program and their budget needs be augmented to cover those costs.

2. Sustainable Agriculture Research and Extension Program (SAREP)

SAREP was established by the University in response to the 1986 Senate Bill No. 872 which arose out of concern for the environmental impact of agriculture, the health of rural communities, and the profitability of family farming operations in California.

SAREP's mission is stated in their November 1, 2000 'Draft' Five-Year Strategic Plan as follows:

> *Mission:* SAREP provides leadership and support for scientific research and education in agricultural and food systems that are sustainable:
>
> economically viable, conserve natural resources and biodiversity, and enhance the quality of life in the state's communities. SAREP serves farmers, farm workers, ranchers, researchers, educators, regulators, policy makers, industry professionals, consumers, and community organizations across the state. SAREP is a Statewide Special Program within the UC Division of Agriculture and Natural Resources.

FINDINGS

This review was not a general review of SAREP as was conducted with CPMRE, OPIC and IPM, but was restricted to those activities of SAREP that involved pest management activities, with particular regard as to how these activities could be coordinated with the IPM Program, campus departments and county advisors.

Coordinating Activities with the IPM Program. In joint discussions with the Directors of the two programs, as well as discussing the issues individually, it appeared that the greatest opportunity for collaboration would be in taking advantage of the strengths of the SAREP staff in developing biointegrated farming systems and in organic farming methods.

Reporting. Several suggestions were put forth to change the reporting of SAREP from the Agricultural Productivity program to the Agricultural Policy and Pest Management program. The logic for this by those proposing the change was to more closely reflect the thrust of their cur-rent program activities, i.e., Alternatives to Methyl Bromide, biological control, etc. The other side of the argument would suggest that such a change would clearly identify SAREP as a "pest management" program whereas their main focus is, or should be, more aligned with crop departments involving cropping systems, soil health, biointensive farming, organic farming methods, etc.

RECOMMENDATIONS

1. That SAREP continue to report programmatically to the Program Leader for Agricultural Productivity. Transferring it under Agr. Policy and Pest Management would imply by association that it is primarily a pest management program which is not it's primary focus.

2. That the Director of SAREP be a member of the SSP Pest Management Cabinet so that electronic information systems, publications, educational programs and grants programs that have a pest management component can be discussed and coordinated with the other pest management programs and centers to avoid duplication and to explore collaborative opportunities.

3. Specific areas of collaboration between the IPM Project and SAREP that should be explored include: 1) SAREP staff providing input on organic methods into the comprehensive pest management guidelines and 2) SAREP staff providing training and workshops for IPM Area Advisors on biointegrated farming systems and organic farming methods.

III. THE CENTER INVASIVE SPECIES RESEARCH AND THE CENTER FOR BIOLOGICAL CONTROL RESEARCH

The Center for Invasive Species Research initiated at UC Riverside, and the Center for Biological Control Research proposed by UC Berkeley were not part of the charge for this review but since both have "Statewide" pest management program implications, they were discussed and considered as part of the overall coordinating organization structure proposed in this review. From these discussions the following recommendations are proposed;

1. That the grants programs of these centers be processed through the IPM Program's administration;

2. That they participate in the proposed DANR Pest Management Web Site;

3. They take advantage of the IPM service units with development of their publications and educational programs.

4. The Center for Invasive Species Research initiated at UC Riverside should be formally designated as a Statewide Special Program (SSP) and the Center for Biological Control Research proposed by UC Berkeley should similarly be designated a SSP at such time as DANR resources are allocated to support such a Center.

1. Center for Invasive Species Research (CISR)

UC Riverside organized the CISR to address a strategic approach to pest invasions by coordinating research that will provide the science behind the policy decisions. CISR is located at UC Riverside but will operate as a statewide DANR research program as unit of the statewide IPM Program. CISR win coordinate efforts with, and draws upon, resources at Berkeley, Davis, Riverside, Cooperative Extension and other statewide programs. In developing effective strategies to combat invasive species, CISR works closely with CDFA, U.S. Department of Agriculture and various industry groups.

2. Center for Biological Control Research (CBCR)

The stated mission of the Center for Biological Control Research is to facilitate project development and implementation of biological control through research, training and extension programs. The Center also provides a forum for intellectual discussion on environmental issues related to ecology and management of pests that pose a threat to our natural resources form wild lands, to food and fiber crops, and urban environments. Affiliates of the Center are drawn from CNR, CLS and the USDA Western Regional Center. However, the Center encourages statewide cooperation between UC, USDA, CDFA and other agencies in the development of collaborative programs. The breadth of activities of the Center reflects the interdisciplinary character of many successful, internationally recognized, biological control programs. In particular, the programs of the Center focus on:

1. The development of biological control solutions for the management of pest problems;

2. The ecology of pest populations; and,

3. The importance of living organisms in regulating the abundance of pests.

IV. THE MOSQUITO RESEARCH PROGRAM AND OFFICE OF THE VICE PRESIDENT GRANTS PROGRAMS

These programs were not specifically included in the review but a brief description of their activities is included. It is also recommended here that the Directors of each these programs be included in the SSP Pest Management Cabinet to ensure coordination with the other statewide projects related to pest management as shown in Figure 1.

1. The Mosquito Research Program (MRP).

The Mosquito Research Program was established in 1972 with funds specifically allocated by the State Legislature to conduct research on control of mosquitoes and mosquito-borne diseases in California. The MRP reports to the Assistant Vice President, Programs through the Program Leader, Agr. Policy and Pest Management.

> *Mission.* The mission of the Mosquito Research Program is to promote research leading to innovative methods of mosquito control, especially methods that avoid the use of broad-spectrum, conventional chemical pesticides. The program also supports research leading to improved methods of surveillance for mosquito-borne diseases such as malaria and encephalitis.

Major program functions include:

1. Operate a research grants program for UC faculty for the conduct of research on the biology and control of mosquitoes and mosquito-borne diseases,
2. Serve as a central planning office for research on mosquito control systemwide;
3. Serve as a public education and information source for the biology and control of mosquitoes and mosquito-borne diseases;
4. Serve as the interface between UC and various state and local agencies for the area of biology and control of mosquitoes and mosquito-borne diseases; and
5. Serve as a resource for UC faculty in identifying financial support for mosquito research, and in assisting in the preparation of research grant applications.

2. Office of the Vice President Grants Programs.

There are several grants programs coordinated by Bob Webster (Dept. Plant Pathology UC Davis) for the Office of the Vice President. These include:

1. Viticulture Consortium. DANR, in cooperation with the California Viticulture Industry and Cornell University formed a Viticulture Consortium in 1996 to promote research to assist the Viticulture industry remain competitive in the future, The Consortium is funded by the USDA Cooperative State Research, Education, and Extension Service (CSREES) to supplement and encourage the Viticulture Industry to continue to provide industry funding for research. The total budget for the Consortium is $1.5 million with California's share at $750,000. It is not mandatory but the industry, including the Raisin Board, Table Grape Commission and the Grape Rootstock Program have matched on a 50-50 basis.

Research areas for consideration and funding have been identified by a program Guidance Committee representing growers, processors, extension personnel and researchers. The process is coordinated with the American Viticulture and Enology Research Network's effort in establishing National research priorities for Viticulture research. DANR's portion of the Consortium accepts proposals from Land Grant and Non-Land Grant Institutions in the Western States where appropriate expertise exists. Both mission oriented studies and fundamental studies are considered.

2. The California Competitive Grant Program in Viticulture and Enology DANR, in consultation and cooperation with the American Vineyard Foundation established the California Competitive Grant Program for Research in ViticuIture and Ecology in 1997. This program is funded by a Legislative special line item budget of $700,000, which is contingent upon matching funds from California's Viticulture and Enology Industry. This grant program is open to all California public institutions with research capabilities to address the needs of the industry. A committee composed of representatives from UC, California State University system, and the California Viticulture and Enology Industry appointed by the Vice President of DANR establish the priority areas for research funding.

3. Pierce's Disease Grants Program. CSREES just recently notified DANR that it has been awarded $1.77 million for research on Pierce's Disease. These funds will also be coordinated out of the OVP.

4. Elvenia J. Slosson Fund for Ornamental Horticulture. In 1970, the Regents established the Elvenia J. Slosson Endowment Fund for the support of research and Extension education in ornamental horticulture. The annual income generated by a gift from Elvenia Slosson is assigned by the OVP, DANR to fund research and education projects by UC researchers and staff. Research and education proposals are solicited annually and evaluated and selected through a competitive review process by and advisory committee consisting of representatives from UC campuses, CE and the California Garden Clubs. Some of the grants awarded relate to pest management activities. The Fund allocates approximately $250,000 annually.

Appendix I

UNIVERSITY OF CALIFORNIA

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO • SAN FRANCISCO

SANTA BARBARA • SANTA CRUZ

OFFICE OF THE VICE PRESIDENT –
AGRICULTURE AND NATURAL RESOURCES

OFFICE OF THE PRESIDENT
Division of Agriculture and Natural Resources
1111 Franklin Street, 6th Floor
Oakland, California 94607-5200

July 7, 2000

ASSISTANT DIRECTOR JIM LYONS

Dear Jim:

I appreciate your willingness to take on the assignment of reviewing the Statewide Special Programs and Projects in the pest management area. As we discussed, your review will be equivalent to the type of quinquennial review, normally conducted by an *ad hoc* Committee, but will differ in that it will focus on five SSPPs instead of one. The units to be reviewed are listed as follows:

1. Integrated Management Program
2. Center for Pest Management Research and Extension
3. Pesticide Impact Assessment Program (PIAP)
4. Pesticide Information and Coordination Program (OPIC)
5. Sustainable Agriculture Research and Extension Program.

I have asked the Directors of these programs to cooperate with you fully in making available materials about the programs and program performance in recent years. In addition, I suspect that you may wish to consult with appropriate department chairs on the three campuses and perhaps with key faculty in making your review.

In conducting your review, you should be guided by the following questions. These questions are not intended to limit the scope of your review, however.

1. Are the mission and program goals of the various SSPPs focused on pest management clearly defined? Are they appropriate?
2. Is the scope of the programs appropriate? Should any of the programmatic scopes be broadened or narrowed?
3. Are the programmatic structures of these units appropriate conceived to facilitate the pursuit of the units mission and programmatic goals? For example, is the mix of research and outreach activities appropriate.

4. How effective are these units in helping to focus the collective energies of the academic staff in the Division of Agriculture and Natural Resources and the campuses on research and extension related to pest management?

5. Are the management structures of these units and the pattern of staffing appropriate for achieving the unit's mission and goals? Are the internal and external oversight bodies appropriately constituted? Do they function effectively?

6. Is there justification for continuing to maintain these SSPP's as independent units, or would some consolidation achieve increased programmatic and/or financial efficiencies? In addressing this question, you should take account of the plans for a new Center for Exotic Pest Management to be located on the Riverside campus and funded through the Integrated Pest Management Program.

My office will provide support for your work and , of course, we will defray the costs of travel and other incidental expenses. I ask that you make every effort to complete your report by **February 1, 2001** so that we will have the results available to us for possible action priori to the 2001-2002 fiscal year.

I look forward with great interest to seeing the fruits of your labors.

Sincerely,

Henry J. Vaux, Jr.
Associate Vice President

c: Assistant Vice President Lund
Program Leader Morse

Appendix II

INTERVIEWS

Berkeley Campus	
Assoc. Dean	Barbara Allen Diaz
Biological Control	Nicholas Mills, Professor
	Don Dahlston, Professor
Davis Campus	
Assoc. Deans	Jim MacDonald
	Mike Parrella
Plant Pathology	Richard M. Bostock, Chair
	Robert Webster, Professor
Nematology	Harry Kaya, Chair
	Howard Ferris, Professor
Entomology	Robert Page, Chair
Env. Toxocology	Marion Miller, Chair
Weed Science	Joe DiTomaso, CE Specialist
	Tom Lanini, CE Specialist
Agronomy & Range Science	Steve Temple, CE Specialist
	Ford Denison, Professor
	Bill Rains, Professor
	Richard Plant, Professor
Riverside Campus	
Assoc. Dean	Phil Roberts
Assoc. Director, IPM - Research	John Menge
Entomology	Nick Toscano, CE Specialist
	Mike Rust, Exotics Center
	Tim Paine, Biological Control
Nematology	Ed Platzer, Chair
Plant Pathology	Doug Cooksey, Chair
Regional Directors	
No. Coast & Mtn.	Kim Rodriguez
Central Valley	Linda Manton
Central Coast & So.	Susan Laughlin
Program Leaders	
Agr. Policy and Pest Management	Joe Morse
Agr. Productivity	Mike Reid
Human Resources	Karen Varco
Natural Resources	Bill Frost

Federal Agencies	
USDA	Rick Melnicoe, Director WRPM Center
State Agencies	
Dept. Pesticide Regulation	Tobi Jones, Assistant Director
CDFA	Michael Pitcairn, Biological Control
	Larry Bezark, Biological Control
	Nathan Dechoretz, Integrated Pest Contr.
	Bill Callison, Plant Health and Protection
County	
Agr. Commissioner	Scott Paulsen, Chair, Agr. Commissioners
Yolo County	Biological Control & IPM Committee,
	(member of SAREP Policy Adv. Com.)
Project Personnel	
IPM	Frank Zalom, Director
	Mary Louise Flint
	Pat O'Conner-Marer
	Pete Goodell, Extension Coordinator
SAREP	Sean Swezey Director
	Jenny Broome, Assoc. Director
CPMRE	Mike Stimmann, Director
Other States	
Texas (e-mail)	Ted Wilson, Professor, Entomology

APPENDIX X

By-Laws—Statewide IPM Program

BYLAWS

OF THE

STATEWIDE INTEGRATED
PEST MANAGEMENT PROGRAM

UNVIERSITY OF CALIFORNIA

November 1, 2002

ARTICLE I. MISSION

Section 1. Purpose.

The Integrated Pest Management Program (the Program) is a Statewide Special Program that reports to the Office of the Associate Vice President - Programs of the University of California, Division of Agriculture and Natural Resources (ANR). The Program was established by the State Legislature July1, 1979 to combine the efforts of research and extension activities that promotes implementation of integrated pest management methods in California.

Integrated pest management (IPM) is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties in urban and agricultural environments. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and non-target organisms, and the environment

The Program's mission is to:

- reduce the pesticide load in the environment;
- increase the predictability and thereby the effectiveness of pest control techniques;
- develop pest control programs that are economically, environmentally, and socially acceptable;
- marshal agencies and disciplines into integrated pest management program;
- increase utilization of natural pest controls.

ARTICLE II. OPERATIONS

Under the overall direction and coordination of the Director, the Program carries out its mandate employing several operations, which collectively provide the interdisciplinary and integrated research and implementation programs for effective IPM practices. These operations include the following:

Section 1. Competitive Research Grants.

a. General. The goal of the grants program is to develop and promote IPM practices and bring them into popular use in California. Grants are awarded on a competitive basis. Consideration is given to principal investigators who demonstrate a commitment to research that promotes implementation of IPM methods, or results in guidelines, or systems that are practical and usable to those carrying out pest management programs in the field. Interdisciplinary projects and programs involving both Agricultural Experiment Station and Cooperative Extension personnel are encouraged. Projects that seek to evaluate impacts of UC IPM research or seek to assess economic impact of specific IPM techniques or programs are given special consideration. The amount of funds available for these grants is limited and the ones awarded are intended to leverage other resources to achieve IPM goals.

b. Review Process. Proposals submitted in response to a request for proposals are reviewed and ranked by the appropriate Review Panel. These reviews and rankings are forwarded to the IPM Technical Committee for final review and rankings within the budget available. The Technical Committee recommends these proposals to the Director who makes the final funding decisions.

c. Review Panels. Review Panels are composed of five to eight AES and CE academics with expertise in the priority areas selected for funding in a given year. In addition, other panel members (e.g., from industry, state or federal agencies, university researchers outside ANR, etc.) may be added to review panels at the discretion of the Director. Review panel members are selected to provide representation from the three agricultural campuses, IPM advisors, farm advisors, and as many pest management disciplines as possible. These members are appointed by the Director, in consultation with the Associate Director for Research. Typically they serve for a period of three years, which may be renewed. Each Panel has a Chair and also may have a Co-Chair.

d. Technical Committee. The Technical committee is composed of the Chairs and Co-Chairs (if any) from each of the Review Panels, the managers of IPM Education and Publications and the Information Systems units, and the IPM Advisor Coordinator. The Technical Committee is chaired by the Associate Director for Research and provides final recommendations for funding to the Director.

e. Eligibility. Each research project must include at least one academic principal investigator (PI) from ANR.

f. Conflict of Interest. If the PI or cooperator of a proposal is a member of an IPM Review Panel, a different panel must review the proposal. Panel chairs are eligible to submit proposals (as a PI or cooperator), however they will not be allowed to participate in the discussions related to their proposals.

g. Grants Awards. Grant awards are made annually and require an annual scientific progress report that includes a lay summary. For each grant awarded, the PI must also provide annual reports of expenditures. The Program must verify that the funds were actually spent in accordance with their approved budget, and the results of the review will be considered before annual allocations are made or new grants are approved.

Section 3. Cooperative Extension Area IPM Advisors.

a. General. Cooperative Extension IPM Advisors are key to fulfilling the mission and objectives of the Program by disseminating research-based pest management information and acting as a bridge linking campus-based researchers, other CE advisors and specialists, growers and pest control professionals. Their primary clientele are the local county-based farm advisors and PCA's.

b. Location. IPM Advisors may be located either in CE county offices, at ANR Research and Extension Centers or on a UC campus, and each has area or regional responsibilities.

c. Administrative Management. The area advisors are managed jointly between the Program and the Cooperative Extension Region or County operating through Memoranda of Understanding agreed upon between the appropriate ANR Regional Director and the IPM Director.

d. Program Management. Program priorities are established in consultation with the IPM Director, the Regional Director, IPM Advisor Coordinator and each of the IPM Advisors as set forth in the MOU.

Section 4. IPM Education and Publications.

a. General. This unit produces publications and other educational materials related to pest management. A staff of professional writers trained in pest management sciences works closely with IPM advisors, county advisors, specialists and researchers to develop state-of-the-art education materials that reflect the newest advances in pest management.

b. Management. The unit manager oversees the program to achieve program priorities established in consultation with the IPM Director.

Section 5. Information Systems.

a. General. This unit develops databases and software to assist the University's statewide pest management extension and applied agricultural research programs. These activities

have a major focus in development and maintenance of online resources implemented through the IPM Web page.

b. Management. The unit manager oversees the program to achieve program priorities established in consultation with the IPM Director.

Section 6. Pesticide Safety Education Program.

a. General. This unit develops publications, training materials and workshops designed to reach employers and workers throughout the state with state-of-the-art pesticide safety information and provides handlers and fieldworkers with skills and knowledge needed to avoid pesticide-related problems.

b. Management. The unit manager oversees the program to achieve program priorities established in consultation with the IPM Director.

ARTICLE III. ADMINISTRATION

A. Section 1. Director

a. Appointment.
(1) The Director shall be appointed by the Associate Vice President, ANR, in accordance with procedures of the University of California.
(2) The Director shall hold an academic appointment in an appropriate subject matter department.
(3) Normally the Director shall be appointed for a period of five to seven years, with the possibility of reappointment for additional terms.

b. Duties.
(1) Provide direction and leadership for UC IPM Program policies, procedures and activities.
(2) Establish program priorities.
(3) Direct a competitive grants program for funding IPM research by ANR academic researchers.
(4) Develop the annual budget for the Program, including both internal and extramural funds. Manage and report on all program funds as required by University policies and procedures.
(5) Serve as administrative contact for USDA-CSREES Smith-Lever 3(d) IPM Extension Funds, and comply with budgetary and reporting requirements.
(6) In consultation with the Associate Director for Research, appoint members to the Technical Committee and Review Panels for the competitive grants program.
(7) In consultation with the IPM Advisor Coordinator, develop and implement Memoranda of Understanding with ANR Regional Directors for management of the Regional and Area IPM Advisors.

(8) Represent the University of California on the California State Department of Pesticide Regulation's Pest Management Advisory Committee.
(9) Represent the Program on the California Steering Committee of the USDA Western Region Pest Management Center and the Experiment Station WRCC-69 IPM Committee.
(10) Communicate the Program's activities through the APPM Program Leader to ANR academics and administrators.
(11) Communicate the Program's activities to external constituencies including pest control advisors, growers, representatives of state and federal government agencies, and the public.
(12) Administer the Office of the Director.

Section 2. Associate Director for Research.

a. Appointment.
(1) The Associate Director for Research shall be appointed by the Director.
(2) The Associate Director for Research shall hold an academic appointment on a campus other than that of the Director.
(3) Normally the Associate Director for Research shall be appointed for a period of three years, with the possibility of reappointment for additional terms.

b. Duties.
(1) The Associate Director for Research shall serve as Chair of the Technical Committee, and work with the IPM Director to identify potential members of the Review Panels for appointment.

Section 3. Coordinator, Extension IPM Advisors.

a. Appointment.
(1) An IPM Advisor Coordinator shall be designated by the Director.
(2) The Coordinator shall be a Cooperative Extension IPM Advisor.
(3) The Coordinator shall serve for a period agreed upon by the Director and the person serving in that role.

b. Duties.
(1) Serve as Director's designee in development of IPM Advisor position descriptions, preparation of IPM Advisor annual performance evaluations and salary advancement recommendations.
(2) Represent the Program as USDA IPM Coordinator for California.
(3) In consultation with the IPM Director develop and report on Plan of Work for Smith-Lever 3(d) IPM Education Funds.
(4) Coordinate extension planning for all IPM advisors.
(5) Develop the budget for IPM Advisors' core programs.

Section 4. IPM Education and Publications Unit Manager.

a. Appointment.
   (1) A manager of the IPM Education and Publications unit shall be appointed by the IPM Director.

b. Duties.
   (1) In consultation with the IPM Director, provide leadership for the IPM Education and Publications unit.
   (2) Develop policies and procedures required for operational activities of the IPM Education and Publications unit.
   (3) Administer budget and staff positions in accordance with Program and University policies and procedures.

Section 5. IPM Information Systems Unit Manager.

a. Appointment.
   (1) The manager of the IPM Information Systems unit shall be appointed by the IPM Director.

b. Duties.
   (1) In consultation with the IPM Director, provide leadership for the IPM Information Systems unit.
   (2) Develop policies and procedures required for operational activities of the IPM Information Services unit.
   (3) Administer budget and staff positions in accordance with Program and University policies and procedures.

Section 6. Pesticide Safety Education Program Unit Manager.

a. Appointment.
   (1) The manager for the Pesticide Safety Education Program unit shall be appointed by the IPM Director.

b. Duties.
   (1) In consultation with the IPM Director provide leadership for the Pesticide Safety Education Program unit.
   (2) Develop policies and procedures required for operational activities of the Pesticide Safety Education Program unit.
   (3) Administer budget and staff positions in accordance with Program and University policies and procedures.
   (4) Represent the University as USDA Pesticide Applicator Training Coordinator.
   (5) Administer USDA-EPA Smith-Lever Pesticide Applicator Training funds in accordance with applicable policies.

ARTICLE IV. AMENDMENTS

Amendments to these Bylaws may be required from time to time and such amendments shall require approval of the Office of the Associate Vice President of the Division of Agriculture and Natural Resources of the University of California.

APPROVED:

Joseph G. Morse	Lanny J. Lund	Henry J. Vaux Jr.
Program Leader	Assistant Vice President	Associate Vice President
APPM	Programs	Programs

APPENDIX XI

Technical Committee Membership By Year

1981-82

Chair	Mary Louise Flint, UC Davis, IPM Manual Group Dir.
IPM Project Director	James M. Lyons, UC Davis
Associate Director	Howard Ferris, Nematology, UC Riverside
Economics	John Baritelle, USDA, UC Riverside
Almonds	Martin M. Barnes, Entomology, UC Riverside
Walnuts*	William W. Barnett, Area IPM Specialist Fresno
Cotton	J. Hodge Black, CE, Kern Co.
Systems Analysis	Wayne M. Getz, Entomology, UC Berkeley
Rice	Albert A. Grigarick, Entomology , UC Davis
Alfalfa	Joe G. Hancock, Plant Pathology, UC Berkeley
CDFA Liaison	Lyndon Hawkins, CDFA, Sacramento
Grapes	Howard Ferris, Nematology, UC Riverside
Citrus	Joe Morse, Entomology, UC Riverside
Computer Network Coord.	Gary E. Smith, IPM Implementation Group, UC Davis
Pest Management Progam Director	Nick C. Toscano, Coop. Extension, UC Riverside
Tomatoes*	Ted Wilson, Entomology, UC Davis
Extension Implementation Coordinator	Frank G. Zalom, IPM Implementation Group, UC Davis

*Designates commodity workgroup chair or co-chair

1983

Chair	Mary Louise Flint, UC Davis, IPM Manual Group Dir.
IPM Project Director	James M. Lyons, UC Davis
Associate Director	Howard Ferris, Nematology, UC Riverside
Economics	John Baritelle, USDA, UC Riverside
Almonds*	Martin M. Barnes, Entomology, UC Riverside
Walnuts*	William W. Barnett, Area IPM Specialist, Fresno
Cereals*	Dave Cudney, CE Weed Scientist, UC Riverside
Systems Analysis	Wayne M. Getz, Entomology, UC Berkeley
Rice*	Albert A. Grigarick, Entomology , UC Davis
Alfalfa*	Joe G. Hancock, Plant Pathology, UC Berkeley
Cotton*	Thomas A. Kerby, Cotton Res. Station, Shafter
CDFA Liaison	George Loughner, CDFA, Sacramento
Grapes*	Michael V. McKenry, Nematology, UC Parlier
Citrus (Co-leader)*	John A. Menge, Plant Pathology, UC Riverside
Citrus (Co-leader)*	Joe Morse, Entomology, UC Riverside
Computer Network Coord.	Gary E. Smith, IPM Implementation Group, UC Davis
Pest Management Progam Director	Nick C. Toscano, Coop. Extension, UC Riverside

Tomatoes*	Ted Wilson, Entomology, UC Davis
Extension Implementation Coordinator	Frank G. Zalom, IPM Implementation Group, UC Davis

*Designates commodity workgroup chair or co-chair

1984

Chair	Mary Louise Flint, UC Davis, IPM Manual Group Dir.
IPM Project Director	James M. Lyons, UC Davis
Associate Director	Howard Ferris, Nematology, UC Riverside
Economics	John Baritelle, USDA, UC Riverside
Walnuts*	William W. Barnett, Area IPM Specialist Fresno
Cereals*	Dave Cudney, CE Weed Science, UC Riverside
Computer System Manager	Joyce Fox, IPM Implementation Group, UC Davis
Systems Analysis	Wayne M. Getz, Entomology, UC Berkeley
Rice*	Albert A. Grigarick, Entomology , UC Davis
Alfalfa*	Joe G. Hancock, Plant Pathology, UC Berkeley
Cotton*	Thomas A. Kerby, Cotton Res. Station, Shafter
CDFA Liaison	Olaf Liefson, CDFA, Sacramento
Grapes*	Michael V. McKenry, Nematology, UC Parlier
Citrus (Co-leader)*	John A. Menge, Plant Pathology, UC Riverside
Citrus (Co-leader)*	Joe Morse, Entomology, UC Riverside
Almonds*	Richard Rice, Entomology, Parlier
Pest Management Program Director	Nick C. Toscano, Coop. Extension, UC Riverside
Tomatoes*	Ted Wilson, Entomology, UC Davis
Extension Implementation Coordinator	Frank G. Zalom, IPM Implementation Group, UC Davis

*Designates commodity workgroup chair or co-chair

1985

Chair	Mary Louise Flint, UC Davis, IPM Manual Group Dir.
Director	James M. Lyons, UC Davis
Associate Director	Howard Ferris, Nematology, UC Riverside
Economics	John Baritelle, USDA, UC Riverside
Walnuts*	William W. Barnett, Area IPM Specialist Fresno
Cereals*	Dave Cudney, CE Weed Scientist, UC Riverside
Computer System Manager.	Joyce Fox, IPM Implementation Group, UC Davis
Systems Analysis	Wayne M. Getz, Entomology, UC Berkeley
Rice*	Albert A. Grigarick, Entomology , UC Davis
Alfalfa*	Joe G. Hancock, Plant Pathology, UC Berkeley
Cotton*	Thomas A. Kerby, Cotton Research Station, Shafter
CDFA Liaison	Lyndon Hawkins, CDFA, Sacramento
Grapes*	Jim Marois, Plant Pathology, UC Davis

Citrus (Co-leader)*	Joe Morse, Entomology, UC Riverside
Almonds*	Richard Rice, Entomology, Parlier
Pest Management Program Director	Nick C. Toscano, Coop. Extension, UC Riverside
Tomatoes*	Ted Wilson, Entomology, UC Davis
Extension Implementation Coordinator	Frank G. Zalom, IPM Implementation Group, UC Davis

*Designates commodity workgroup chair or co-chair

Fall 1986

Chair	Mary Louise Flint, UC Davis, IPM Manual Group Dir.
Director	James M. Lyons, UC Davis
Commodity-Pest Interactions	Phil Roberts, Nematology, Kearney Ag. Ctr.
Cultural Controls	Bill Williams, Agronomy & Range Science, UC Davis
Biological Controls	Don Dahlston, Div. Biological Control, UC Berkeley
Monitoring Systems	Jim Marois, Plant Pathology, UC Davis
Systems Applications	L. Ted Wilson, Entomology, UC Davis
Implementation and Evaluation	John Antle, Agricultural Economics, UC Davis
Extension Implementation Coordinator	Frank Zalom, IPM Implementation Group, UC Davis
Computer Systems Manager	Joyce Fox, IPM Implementation Group, UC Davis

Fall 1987

Chair	Mary Louise Flint, UC Davis, IPM Manual Group Dir.
Director	James M. Lyons, UC Davis
Commodity-Pest Interactions	Phil Roberts, Nematology, Kearney Ag. Ctr.
Cultural Controls	Bill Williams, Agronomy & Range Science, UC Davis
Biological Controls	Don Dahlston, Div. Biological Control, UC Berkeley
Monitoring Systems	Jim Marois, Plant Pathology, UC Davis
Systems Applications	L. Ted Wilson, Entomology, UC Davis
Implementation and Evaluation	John Antle, Agricultural Economics, UC Davis
Extension Implementation Coordinator	Frank Zalom, IPM Implementation Group, UC Davis
Computer Systems Manager	Joyce Fox Strand, IPM Implementation Group, UC Davis

Fall 1988

Chair	Mary Louise Flint, UC Davis, IPM Manual Group Dir.
Assoc. Director for Research	Joseph Morse, Entomology, UC Riverside
Commodity-Pest Interactions	Dave Cudney, Botany & Plant Sciences, UC Riverside
Cultural Controls	Milton Schroth, Plant Pathology, UC Berkeley
Biological Controls	Don Dahlston, Div. Biological Control, UC Berkeley
Monitoring Systems	Jim Marois, Plant Pathology, UC Davis
Systems Application	L. Ted Wilson, Entomology, UC Davis
Extension Implementation Coordinator	Frank Zalom, IPM Implementation Group, UC Davis
Computer Systems Manager	Joyce Fox Strand, IPM Implementation Group, UC Davis

Fall 1989

Chair and Associate Director for Research	Joseph Morse, Entomology, UC Riverside
Commodity-Pest Interactions	Dave Cudney, Botany & Plant Sciences, UC Riverside
Cultural Controls	Milton Schroth, Plant Pathology, UC Berkeley
Biological Controls	Don Dahlston, Div. Biological Control, UC Berkeley
Monitoring Systems	Charles Summers, Entomology, Kearney Ag. Center
Systems Application	Howard Ferris, Nematology, UC Davis
Extension IPM Coordinator	Peter Goodell, IPM Area Advisor, Kern County
Computer Systems Manager	Joyce Fox Strand, IPM Implementation Group, UC Davis
IPM Education and Publications Director	Mary Louise Flint, IPM Project, UC Davis

Fall 1990

Chair and Associate Director for Research	Joseph Morse, Entomology, UC Riverside
Commodity-Pest Interactions	Dave Cudney, Botany & Plant Sciences, UC Riverside
Cultural Controls	Milton Schroth, Plant Pathology, UC Berkeley
Biological Controls	Don Dahlston, Div. Biological Control, UC Berkeley
Monitoring Systems	Charles Summers, Entomology, Kearney Ag. Center
Systems Application	Howard Ferris, Nematology, UC Davis
Extension IPM Coordinator	Peter Goodell, IPM Area Advisor, Kern County
Computer Systems Manager	Joyce Fox Strand, IPM Implementation Group, UC Davis
IPM Education and Publications Director	Mary Louise Flint, IPM Project, UC Davis

Fall 1991

Chair and Associate Director for Research	Joseph Morse, Entomology, UC Riverside
Applied Field Ecology	Charles Summers, Entomology, KAC
Biological Controls	Tom Bellows, Entomology, UC Riverside
Biorational Use of Biotic Agents	Milton Schroth, Plant Pathology, UC Berkeley
Cultural Controls	Tom Lanini, Botany, UC Davis
Decision Support	Howard Ferris, Nematology, UC Davis
Extension IPM Coordinator	Peter Goodell, Area IPM Advisor, KAC
Computer Systems Manager	Joyce Fox Strand, UC IPM, Davis
IPM Education and Publications Director	Mary Louise Flint, UC IPM, Davis

Fall 1992

Chair and Associate Director for Research	Joseph Morse, Entomology, UC Riverside
Applied Field Ecology	Richard Goeden, Entomology, UC Riverside
Biological Controls	Tom Bellows, Entomology, UC Riverside
Biorational Use of Biotic Agents	Milton Schroth, Plant Pathology, UC Berkeley
Cultural Controls	Bruce Kirkpatrick, Plant Pathology, UC Davis
Decision Support	Howard Ferris, Nematology, UC Davis
Extension IPM Coordinator	Peter Goodell, Area IPM Advisor, KAC
Computer Systems Manager	Joyce Fox Strand, UC IPM, Davis
IPM Education and Publications Director	Mary Louise Flint, UC IPM, Davis

Fall 1993

Chair and Associate Director for Research	Philip Roberts, Nematology, UC Riverside
Applied Field Ecology	Richard Goeden, Entomology, UC Riverside
Biological Controls	Kent Daane, Entomology, UC Berkeley
Biorational Use of Biotic Agents	Steve Lindow, Plant Pathology, UC Berkeley
Cultural Controls	Bruce Kirkpatrick, Plant Pathology, UC Davis
Decision Support	Howard Ferris, Nematology, UC Davis
Extension IPM Coordinator	Peter Goodell, Area IPM Advisor, KAC
Computer Systems Manager	Joyce Fox Strand, UC IPM, Davis
IPM Education and Publications Director	Mary Louise Flint, UC IPM, Davis

Fall 1994

Chair and Associate Director for Research	Philip Roberts, Nematology, UC Riverside
Applied Field Ecology	Richard Goeden, Entomology, UC Riverside
Biological Controls	Kent Daane, Entomology, UC Berkeley
Biorational Use of Biotic Agents	Steve Lindow, Plant Pathology, UC Berkeley
Cultural Controls	Bruce Kirkpatrick, Plant Pathology, UC Davis
Decision Support	Howard Ferris, Nematology, UC Davis
Extension IPM Coordinator	Peter Goodell, Area IPM Advisor, KAC
Computer Systems Manager	Joyce Fox Strand, UC IPM, Davis

IPM Education and Publications Director	Mary Louise Flint, UC IPM, Davis

Fall 1995

Chair and Associate Director for Research	Philip Roberts, Nematology, UC Riverside
Applied Field Ecology	Richard Goeden, Entomology, UC Riverside
Biological Controls	Jay Rosenheim, Entomology, UC Davis
Biorational Use of Biotic Agents	Steve Lindow, Plant Pathology, UC Berkeley
Cultural Controls	Bruce Kirkpatrick, Plant Pathology, UC Davis
Decision Support	Edward Caswell-Chen,, Nematology, UC Davis
Extension IPM Coordinator	Peter Goodell, Area IPM Advisor, KAC
Computer Systems Manager	Joyce Fox Strand, UC IPM, Davis
IPM Education and Publications Director	Mary Louise Flint, UC IPM, Davis

Fall 1996

Chair and Associate Director for Research	Philip Roberts, Nematology, UC Riverside
Applied Field Ecology	Jodie Holt, Botany & Plant Science, UC Riverside
Biological Controls	Jay Rosenheim, Entomology, UC Davis
Biorational Use of Biotic Agents	Steve Lindow, Plant Pathology, UC Berkeley
Cultural Controls	Bruce Kirkpatrick, Plant Pathology, UC Davis
Decision Support	Edward Caswell-Chen,, Nematology, UC Davis
Extension IPM Coordinator	Peter Goodell, Area IPM Advisor, KAC
Computer Systems Manager	Joyce Fox Strand, UC IPM, Davis
IPM Education and Publications Director	Mary Louise Flint, UC IPM, Davis

Fall 1997

Chair and Associate Director for Research	John Menge, Plant Pathology, UC Riverside
Applied Field Ecology	Jodie Holt, Botany & Plant Science, UC Riverside
Biological Controls	Jay Rosenheim, Entomology, UC Davis
Biorational Use of Biotic Agents	Joe Hancock, ESPM, UC Berkeley
Cultural Controls	Steve Welter, ESPM, UC Berkeley
Decision Support	Edward Caswell-Chen,, Nematology, UC Davis
Extension IPM Coordinator	Peter Goodell, Area IPM Advisor, KAC
Computer Systems Manager	Joyce Fox Strand, UC IPM, Davis
IPM Education and Publications Director	Mary Louise Flint, UC IPM, Davis

Fall 1998

Chair and Associate Director for Research	John Menge, Plant Pathology, UC Riverside
Applied Field Ecology	Jodie Holt, Botany & Plant Science, UC Riverside
Biological Controls	Lynn Epstein, Plant Pathology, UC Davis
Biorational Use of Biotic Agents	Mike Davis, Plant Pathology, UC Davis
Cultural Controls	Steve Welter, ESPM, UC Berkeley
Decision Support	Donald Cooksey, Plant Pathology, UC Riverside
Extension IPM Coordinator	Peter Goodell, Area IPM Advisor, KAC
Computer Systems Manager	Joyce Fox Strand, UC IPM, Davis
IPM Education and Publications Director	Mary Louise Flint, UC IPM, Davis

Fall 1999

Chair and Associate Director for Research	John Menge, Plant Pathology, UC Riverside
Applied Field Ecology	Joe DiTomaso, Vegetable Crops, UC Davis
Biological Controls	Nick Mills, Insect Biology, UC Berkeley
Biorational Use of Biotic Agents	Mike Davis, Plant Pathology, UC Davis
Cultural Controls	Beth Grafton-Cardwell, Entomology, UC Riverside/KAC
Decision Support	Donald Cooksey, Plant Pathology, UC Riverside
Extension IPM Coordinator	Peter Goodell, Area IPM Advisor, KAC
Computer Systems Manager	Joyce Fox Strand, UC IPM, Davis
IPM Education and Publications Director	Mary Louise Flint, UC IPM, Davis

Fall 2000

Chair and Associate Director for Research	Michael Rust, Entomology, UC Riverside
Applied Field Ecology	Joe DiTomaso, Vegetable Crops, UC Davis
Biological Controls	Nick Mills, Insect Biology, UC Berkeley
Biorational Use of Biotic Agents	Mike Davis, Plant Pathology, UC Davis
Cultural Controls	Beth Grafton-Cardwell, Entomology, UC Riverside/KAC
Decision Support	Donald Cooksey, Plant Pathology, UC Riverside
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Computer Systems Manager	Joyce Fox Strand, UC IPM, Davis
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Fall 2001

Chair and Associate Director for Research	Michael Rust, Entomology, UC Riverside
Applied Field Ecology	Joe DiTomaso, Vegetable Crops, UC Davis
Biological Controls	Nick Mills, Insect Biology, UC Berkeley
Biorational Use of Biotic Agents	Mike Davis, Plant Pathology, UC Davis
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Extension IPM Coordinator	Peter Goodell, Area IPM Advisor, KAC
Computer Systems Manager	Joyce Fox Strand, UC IPM, Davis
IPM Education and Publications Director	Mary Louise Flint, UC IPM, Davis

Fall 2002

Chair and Associate Director for Research	Michael Rust, Entomology, UC Riverside
Applied Field Ecology	Joe DiTomaso, Vegetable Crops, UC Davis
Biological Controls	Nick Mills, Insect Biology, UC Berkeley
Biorational Use of Biotic Agents	Mike Davis, Plant Pathology, UC Davis
Cultural Controls	Beth Grafton-Cardwell, Entomology, UC Riverside/KAC
Decision Support	Donald Cooksey, Plant Pathology, UC Riverside
Extension IPM Coordinator	Peter Goodell, Area IPM Advisor, KAC
Computer Systems Manager	Joyce Fox Strand, UC IPM, Davis
IPM Education and Publications Director	Mary Louise Flint, UC IPM, Davis

APPENDIX XII

UC Statewide IPM Program Staff

1979-80

Interim Director:	James M. Lyons, UC Davis
Associate Director:	Andrew Gutierrez, UC Berkeley
IPM Manual Group:	Mary Louise Flint, IPM Analyst, Director, UC Davis Brunhilde Kobbe, Senior Writer Paul Rude, Senior Writer
IPM Implementation Staff:	Frank Zalom, CE IPM Specialist, UC Davis Carolyn Pickel, Area Advisor, Santa Cruz Co. Bill Barnett, Area Advisor, Fresno Co. Bud Beasley, Area Advisor, Imperial Co.
Core Staff:	Gary Smith, IPM Analyst, UC Davis Ted Wilson, IPM Analyst, Parlier

1980-81

Director:	Ivan J. Thomason, UC Riverside
Associate Director:	Andrew Gutierrez, UC Berkeley
IPM Manual Group:	Mary Louise Flint, Director, UC Davis Jack Kelly Clark, Principal Photographer Brunhilde Kobbe, Senior Writer Paul Rude, Senior Writer Tobi Jones, Coordinator for Pesticide Directories (CDFA contract)
IPM Implementation Staff:	Frank Zalom, Coordinator, UC Davis William W. Barnett, San Joaquin Valley, Fresno Co. Charles (Bud) Beasley, Desert Areas, Imperial Co. Peter B. Goodell, Southern San Joaquin, Kern Co. Phil S. McNally, Northern San Joaquin Valley, San Joaquin Co. Phil Phillips, South Coast, Ventura Co. Carolyn Pickel, Central Coast, Santa Cruz Co. Craig Weakley, Northern Sacramento Valley, Yuba Co.
IPM Computer Network:	Gary Smith, Coordinator, UC Davis

	Buz Dreyer, Senior Programmer
	Robert Horen, Programmer
	John Rasmussen, Programmer, Parlier
	Gabor Sepfy, Programmer
	Ann Strawn, Programmer, UC Riverside
	L. Ted Wilson, UC, Parlier

1981-82

Director:	James M. Lyons, UC Davis
Associate Director:	Howard Ferris, Nematology, UC Riverside
Assistant to the Director and Chair, Technical Committee:	Mary Louise Flint, IPM Manual Group
Administrative Staff:	Leah Hansen, Administrative Assistant
	Suzanne Roodzant, Senior Clerk
IPM Implementation Staff:	Frank Zalom, Coordinator, UC Davis
	William W. Barnett, San Joaquin Valley, Fresno Co.
	Charles (Bud) Beasley, Desert Areas, Imperial Co.
	Peter B. Goodell, Southern San Joaquin, Kern Co.
	Phil S. McNally, Northern San Joaquin Valley, San Joaquin Co.
	Phil Phillips, South Coast, Ventura Co.
	Carolyn Pickel, Central Coast, Santa Cruz Co.
	Craig Weakley, Northern Sacramento Valley, Yuba Co.
IPM Manual Group:	Mary Louise Flint, Director, UC Davis (alfalfa, rice, cole crops, lettuce)
	Jack Kelly Clark, Principal Photographer
	Brunhilde Kobbe, Senior Writer (walnuts, citrus)
	Barbara Peterson, Senior Writer (almonds)
	Paul Rude, Senior Writer (tomatoes, cotton)
	Betty Rudd, Secretary
IPM Computer Network:	Gary Smith, Coordinator, UC Davis
	William (Buz) Dreyer, Senior Programmer
	Edward G. Morgan, Senior Programmer
	Joyce Fox, Biometeorologist
	John Rasmussen, Programmer, San Joaquin Valley Res. & Extension Center
	Ann Strawn, Programmer, Entomology, UC Riverside

1983

Director:	James M. Lyons, UC Davis
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IPM Manual Group:	Mary Louise Flint, Director, CE Communications Specialist, UC Davis Jack Kelly Clark, Principal Photographer Barbara Peterson, Senior Writer (almonds) Paul Rude, Senior Writer (tomatoes, cotton) Betty Rudd, Secretary
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1984

Director:	James M. Lyons, UC Davis
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IPM Computer Network:	Joyce Fox, Computer System Manager, UC Davis William (Buz) Dreyer, Senior Programmer Edward G. Morgan, Senior Programmer John Rasmussen, Programmer, San Joaquin Valley Res. & Ext. Center Ann Strawn, Programmer, Entomology, UC Riverside
IPM Modeling Staff:	Gary Smith, Specialist in the AES (alfalfa, almonds and walnuts) David Williams, Specialist in the AES (citrus, cereals, and grapes)

1985

Director:	James M. Lyons, UC Davis
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IPM Computer Network:	Joyce Fox, Computer System Manager, UC Davis William (Buz) Dreyer, Senior Programmer Chung-Hsin Lin, Assistant Programmer Edward G. Morgan, Senior Programmer Linda Jones, Meteorology Assistant John Rasmussen, Programmer, San Joaquin Valley Res. & Ext. Center Ann Strawn, Programmer, Entomology, UC Riverside
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	Patrick Marer, Senior Writer
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	Larry Strand, Senior Writer
	Cindy Bonnar, Secretary
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1987

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	John Studdert, Northern Sacramento Valley, Yuba Co.
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	Larry Strand, Senior Writer
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	Kathy Minta, Meteorology Assistant
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	Phil Phillips, South Coast, Ventura Co.
	James Stapleton, Northern San Joaquin Valley, Stanislaus Co.
	John Studdert, Northern Sacramento Valley, Yuba Co.
	Vacancy, North Coast, Sonoma Co.
IPM Education and Publications:	Mary Louise Flint, Director, CE Specialist, UC Davis
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	Larry Strand, Senior Writer
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	Shirley Humphrey, Pest Management Seminar Coordinator
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	Chung-Hsin Lin, Assistant Programmer
	Susan Carl, Meteorology Assistant
	John Rasmussen, Programmer, San Joaquin Valley Res. & Ext. Center
	Ann Strawn, Programmer, Entomology, UC Riverside
IPM Modeling Staff:	Vacancy, Specialist in the AES (alfalfa, almonds, and walnuts)
	Vacancy, Specialist in the AES (citrus, cereals, and grapes)

1989

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	Carolyn Pickel, Central Coast, Santa Cruz Co.
	Phil Phillips, South Coast, Ventura Co.
	James Stapleton, Northern San Joaquin Valley, Stanislaus Co.
	John Studdert, Northern Sacramento Valley, Yuba Co.
IPM Education and Publications:	Mary Louise Flint, Director, CE Specialist, UC Davis
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	Barbara Ohlendorf, Senior Writer
	Larry Strand, Senior Writer
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	Melanie Zavala, Farmworker Pesticide Training Coordinator
	Gale Chun, Staff Assistant
	Margaret Brush, Editorial Assistant
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	William (Buz) Dreyer, Programmer/Analyst

	Edward G. Morgan, Programmer/Analyst
	Linda Bernheim, Programmer/Analyst
	Chung-Hsin Lin, Assistant Programmer/Analyst
	Susan Carl, Meteorology Assistant
	Jeannie Kwan, Lab Assistant
	Donna Seaver, Writer
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1990

Director:	Frank G. Zalom, UC Davis
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	Phil Phillips, South Coast, Ventura Co.
	Carolyn Pickel, Central Coast, Santa Cruz Co.
	James Stapleton, Northern San Joaquin Valley, Stanislaus Co.
	Vacancy, Northern Sacramento Valley, Yuba Co.
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	Barbara Ohlendorf, Senior Writer
	Larry Strand, Senior Writer
	Patrick Marer, Pesticide Training Coordinator
	Melanie Zavala, Farmworker Pesticide Training Coordinator
	Gale Chun, Program Assistant
	Margaret Brush, Editorial Assistant
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	William (Buz) Dreyer, Programmer/Analyst
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	Chung-Hsin Lin, Assistant Programmer/Analyst

	Susan Carl, Meteorology Assistant
	Donna Seaver, Writer
	Ann Strawn, Programmer/Analyst, Entomology, UC Riverside

1991

Director:	Frank G. Zalom, UC Davis
Associate Director for Research:	Joseph Morse, Entomology, UC Riverside
Administrative Staff:	Joyce Fox Strand, Manager
	Cheryl Morris, Administrative Assistant
	Marilyn Herrmann, Grants Assistant
	Suzanne Roodzant, Secretary
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	Sue Blodgett, North Coast, Sonoma Co.
	Phil Phillips, South Coast, Ventura Co.
	Carolyn Pickel, Central Coast, Santa Cruz Co.
	James Stapleton, Northern San Joaquin Valley, Stanislaus Co.
	Vacancy, Northern Sacramento Valley, Yuba Co.
IPM Education and Publications:	Mary Louise Flint, Director, CE Specialist, UC Davis
	Steve Dreistadt, Senior Writer
	Mark Grimes, Writer
	Barbara Ohlendorf, Senior Writer
	Larry Strand, Senior Writer
	Patrick Marer, Pesticide Training Coordinator
	Lupe Sandoval, Pesticide Educator
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	Melanie Zavala, Farmworker Pesticide Training Coordinator
	Gale Chun, Program Assistant
	Margaret Brush, Editorial Assistant
	Christine Joshel, Secretary
	Jack Kelly Clark, Principal Photographer
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	William (Buz) Dreyer, Programmer/Analyst
	Edward G. Morgan, Programmer/Analyst

	Chung-Hsin Lin, Assistant Programmer/Analyst
	Susan Carl, Meteorology Assistant
	Donna Seaver, Writer
	Ann Strawn, Programmer/Analyst, Entomology, UC Riverside

1992

Director:	Frank G. Zalom, UC Davis
Acting Director:	James M. Lyons (9/1/92-6/30/93)
Associate Director for Research:	Joseph Morse, Entomology, UC Riverside
Administrative Staff:	Joyce Fox Strand, Manager
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	Marilyn Herrmann, Grants Assistant
	Suzanne Roodzant, Secretary
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	Agricultural Center.
	Charles (Bud) Beasley, Desert Areas, Riverside Co.
	Phil Phillips, South Coast, Ventura Co.
	Carolyn Pickel, Central Coast, Santa Cruz Co.
	Tim Prather, South Central Valley, Kearney Agricultural Center
	James Stapleton, Northern San Joaquin Valley, Stanislaus Co.
	Vacancy, Northern Sacramento Valley, Yuba Co.
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IPM Education and Publications:	Mary Louise Flint, Director, CE Specialist, UC Davis
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	Brian Corriear, Writer
	Mark Grimes, Writer
	Barbara Ohlendorf, Senior Writer
	Larry Strand, Senior Writer
	Patrick Marer, Pesticide Training Coordinator
	Lupe Sandoval, Pesticide Educator
	Melanie Zavala, Farmworker Pesticide Training Coordinator
	Gale Chun, Staff Assistant
	Margaret Brush, Editorial Assistant
	Christine Joshel, Secretary
	Jack Kelly Clark, Principal Photographer

IPM Computer Systems:	Joyce Fox Strand, Computer System Manager, UC Davis
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	Edward G. Morgan, Programmer/Analyst
	Chung-Hsin Lin, Assistant Programmer/Analyst
	Susan Carl, Meteorology Assistant
	Donna Seaver, Writer
	Ann Strawn, Programmer/Analyst, Entomology, UC Riverside

1993

Director:	Frank G. Zalom, UC Davis
Associate Director for Research:	Phil Roberts, Nematology, UC Riverside
Administrative Staff:	Joyce Fox Strand, Manager
	Cheryl Morris, Administrative Assistant
	Donna Connolly, Administrative Assistant
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IPM Area Advisors:	Peter Goodell, Coordinator, Southern San Joaquin Valley, Kern Co.
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	Carolyn Pickel, Sacramento Valley, Yuba Co.
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	Melanie Zavala, Farmworker Pesticide Training Coordinator
	Gale Chun, Program Assistant
	Margaret Brush, Editorial Assistant
	Christine Joshel, Secretary
	Jack Kelly Clark, Principal Photographer

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	Edward G. Morgan, Programmer/Analyst
	Chung-Hsin Lin, Assistant Programmer/Analyst
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1994

Director:	Frank G. Zalom, UC Davis
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Administrative Staff:	Joyce Fox Strand, Manager
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	Carolyn Pickel, Sacramento Valley, Yuba Co.
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	James Stapleton, Northern San Joaquin Region, Kearney Agricultural Center
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IPM Computer Systems:	Joyce Fox Strand, Computer System Manager, UC Davis William (Buz) Dreyer, Programmer/Analyst Edward G. Morgan, Programmer/Analyst Ferdinando (Marty) Martino, Meteorology Assistant Donna Seaver, Writer Erin Borden, Postgraduate Researcher Ann Strawn, Programmer/Analyst

1995

Director:	Frank G. Zalom, UC Davis
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Administrative Staff:	Joyce Fox Strand, Manager Cheryl Morris, Administrative Assistant Donna Connolly, Grants Assistant
IPM Area Advisors:	Peter Goodell, Coordinator, Kearney Agricultural Center Walt Bentley, South Central Region, Kearney Agricultural Center Phil Phillips, South Coast, Ventura Co. Carolyn Pickel, Sacramento Valley, Yuba Co. Tim Prather, South Central Region, Kearney Agricultural Center James Stapleton, Northern San Joaquin Region, Kearney Agricultural Center Lucia Varela, North Coast, Sonoma Co. Cheryl Wilen, South Coast, San Diego Co.
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	Edward G. Morgan, Programmer/Analyst
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1996

Director:	Frank G. Zalom, UC Davis
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Administrative Staff:	Joyce Fox Strand, Manager
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	Carolyn Pickel, Sacramento Valley, Yuba Co.
	Tim Prather, South Central Region, Kearney Agricultural Center
	James Stapleton, Northern San Joaquin Region, Kearney Agricultural Center
	Lucia Varela, North Coast, Sonoma Co.
	Cheryl Wilen, South Coast, San Diego Co.
IPM Education and Publications:	Mary Louise Flint, Director, CE Specialist, UC Davis
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	Patricia Gouveia, Senior Writer
	Barbara Ohlendorf, Senior Writer
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	Margaret Brush, Assistant Editor
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	Kathy Garvey, Writer
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IPM Computer Systems:	Joyce Fox Strand, Computer System Manager, UC Davis
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1997

Director:	Frank G. Zalom, UC Davis
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	Phil Phillips, South Coast, Ventura Co.
	Carolyn Pickel, Sacramento Valley, Yuba Co.
	Tim Prather, South Central Region, Kearney Agricultural Center
	James Stapleton, Northern San Joaquin Region, Kearney Agricultural Center
	Lucia Varela, North Coast, Sonoma Co.
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IPM Education and Publications:	Mary Louise Flint, Director, CE Specialist, UC Davis
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	Barbara Ohlendorf, Senior Writer
	Larry Strand, Senior Writer
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	Shawn King, Administrative Assistant
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	Diane Clarke, Secretary
	Kathy Garvey, Writer
	Jennifer Weber, Pesticide Educator
	Melanie Zavala, Farmworker Pesticide Training Coordinator
IPM Computer Systems:	Joyce Fox Strand, Computer System Manager, UC Davis
	William (Buz) Dreyer, Programmer/Analyst
	Edward G. Morgan, Programmer/Analyst
	Ferdinando (Marty) Martino, Meteorology Assistant
	Nena Bloom, Postgraduate Researcher
	Donna Seaver, Writer
	Michael Kohl, Computer Resource Specialist

1998

Director:	Frank G. Zalom, UC Davis
Associate Director for Research:	John Menge, Plant Pathology, UC Riverside
Administrative Staff:	Joyce Fox Strand, Manager
	Cheryl Morris, Administrative Assistant
	Donna Connolly, Grants Assistant
	Laura Cauchi, Secretary
	Michael Kohl, Computer Resource Specialist
IPM Area Advisors:	Peter Goodell, Coordinator, Kearney Agricultural Center
	Walt Bentley, South Central Region, Kearney Agricultural Center
	Phil Phillips, South Coast, Ventura Co.
	Carolyn Pickel, Sacramento Valley, Yuba Co.
	Tim Prather, South Central Region, Kearney Agricultural Center
	James Stapleton, Northern San Joaquin Region, Kearney Agricultural Center
	Lucia Varela, North Coast, Sonoma Co.
	Cheryl Wilen, South Coast, San Diego Co.
IPM Education and Publications:	Mary Louise Flint, Director, CE Specialist, UC Davis
	Steve Dreistadt, Senior Writer

	Patricia Gouveia, Senior Writer
	Barbara Ohlendorf, Senior Writer
	Larry Strand, Senior Writer
	Margaret Brush, Assistant Editor
	Shawn King, Administrative Assistant
	Cheryl Reynolds, Postgraduate Researcher
Pesticide Education Program:	Patrick Marer, Pesticide Training Coordinator
	Gale Perez, Program Assistant
	Diane Clarke, Secretary
	Kathy Garvey, Writer
	Jennifer Weber, Pesticide Educator
	Melanie Zavala, Farmworker Pesticide Training Coordinator
IPM Computer Systems:	Joyce Fox Strand, Computer System Manager, UC Davis
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	Edward G. Morgan, Programmer/Analyst
	Ferdinando (Marty) Martino, Meteorology Assistant
	Andrew Corbett, Programmer/Analyst
	Donna Seaver, Writer

1999

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	Donna Connolly, Grants Assistant
	Laura Cauchi, Secretary
	Michael Kohl, Computer Resource Specialist
IPM Area Advisors:	Peter Goodell, Coordinator, Kearney Agricultural Center
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	Phil Phillips, South Coast, Ventura Co.
	Carolyn Pickel, Sacramento Valley, Yuba Co.
	Tim Prather, South Central Region, Kearney Agricultural Center
	James Stapleton, Northern San Joaquin Region, Kearney Agricultural Center
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	Gale Perez, Program Assistant
	Diane Clarke, Secretary
	Jennifer Weber, Pesticide Educator
	Melanie Zavala, Farmworker Pesticide Training Coordinator
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	Edward G. Morgan, Programmer/Analyst
	Ferdinando (Marty) Martino, Meteorology Assistant
	Andrew Corbett, Programmer/Analyst
	Kathy Garvey, Writer

2000

Director:	Frank G. Zalom, UC Davis
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	Phil Phillips, South Coast, Ventura Co.
	Carolyn Pickel, Sacramento Valley, Yuba Co.
	Vacant, South Central Region, Kearney Agricultural Center
	James Stapleton, Northern San Joaquin Region, Kearney

	Agricultural Center
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	Cheryl Wilen, South Coast, San Diego Co.
IPM Education and Publications	Mary Louise Flint, Director, CE Specialist, UC Davis
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	Patricia Gouveia, Senior Writer
	Barbara Ohlendorf, Senior Writer
	Larry Strand, Senior Writer
	Margaret Brush, Assistant Editor
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	Jennifer Weber, Pesticide Educator
	Melanie Zavala, Farmworker Pesticide Training Coordinator
IPM Computer Systems:	Joyce Fox Strand, Computer System Manager, UC Davis
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	Edward G. Morgan, Programmer/Analyst
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	Kathy Garvey, Writer

2001

Director:	Frank G. Zalom, UC Davis
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	Donna Connolly, Grants Assistant
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	Phil Phillips, South Coast, Ventura Co.
	Carolyn Pickel, Sacramento Valley, Yuba Co.
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	James Stapleton, Northern San Joaquin Region, Kearney Agricultural Center
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	Patricia Gouveia, Senior Writer
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	Melanie Zavala, Farmworker Pesticide Training Coordinator
	Sonja Brodt, Program Evaluation Specialist
IPM Computer Systems:	Joyce Fox Strand, Computer System Manager, UC Davis
	William (Buz) Dreyer, Programmer/Analyst
	Edward G. Morgan, Programmer/Analyst
	Ferdinando (Marty) Martino, Meteorology Assistant
	Kathy Garvey, Writer

2002

Interim Director:	James M. Lyons, UC Davis
Associate Director for Research:	Michael Rust, Entomology, UC Riverside
Administrative Staff:	Joyce Fox Strand, Manager
	Cheryl Morris, Business Manager
	Donna Connolly, Grants Assistant
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	Michael Kohl, Computer Resource Specialist
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	Barbara Ohlendorf, Senior Writer
	Larry Strand, Senior Writer
	Cheryl Reynolds, Interactive Learning Developer
	Margaret Brush, Assistant Editor
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Pesticide Education Program:	Patrick Marer, Pesticide Training Coordinator
	Gale Perez, Program Assistant
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	Melanie Zavala, Farmworker Pesticide Training Coordinator
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	Tim Stock, Pesticide Safety Educator
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	Edward G. Morgan, Programmer/Analyst
	Ferdinando (Marty) Martino, Meteorology Assistant
	Kathy Garvey, Writer

APPENDIX XIII

Statewide IPM Program Publications

UC IPM Series

Title	Year published	Series number
Managing Mites in Almonds: An Integrated Approach	1984	UC IPM Publ 1
Codling Moth Management Using Degree-Days	1986	UC IPM Publ 4
Evaluation of California's Almond IPM Program	1987	UC IPM Publ 6
Managing Dicofol and Propargite Resistance in Spider Mites Infesting San Joaquin Valley Cotton	1987	UC IPM Publ 5
Bibliography of Research 1980-1990	1990	UC IPM Publ 10
Establishing Integrated Pest Management Policies and Programs: A Guide for Public Agencies	1991 , 2003	Publ 8093 (formerly UC IPM Publ 12)
Reducing Insecticide Use and Energy Costs in Citrus Pest Management	1992	UC IPM Publ 15 (duplicate #)
Whiteflies in California: A Resource for Cooperative Extension	1995	UC IPM Publ 19
Manual for Research Version of the Generalized Population Model	1985,1987	UC IPM Publ 2

Software, Databases, and Documentation

Title	Year	Series number
DDU: Degree-Day Utility User's Guide, Ver. 1	1987	UC IPM Publ 3
CALEX/Cotton: User's Guide	1988	UC IPM Publ 7
Alfalfa, Vers. 1.4	1989	
Call IPM: User's Guide	1990	UC IPM Publ 11
DDU: Degree-Day Utility User's Guide, Vers. 2.0	1990	UC IPM Publ 9
CALEX/Cotton: User's Guide, Vers. 4.1	1991	
CALEX/Peach	1991	
California Average Weather Data Set	1991	
IMPACT User's Manual	1991	UC IPM Publ 15 (duplicate #)
TRAP, Vers. 2	1991	UC IPM Publ 13
CALEX/Cotton: User's Guide, Vers. 4	1991	UC IPM Publ 8
Pesticide Use Summaries Database: User's Guide	1992	UC IPM Publ 16 (duplicate #)
DDU: Degree-Day Utility User's Guide, Vers. 2.3	1994	
IMPACT User's Manual	1994	UC IPM Publ 16 (duplicate #)

CALEX/Rice: User's Guide, Vers. 1	1994, 1995	UC IPM Publ 18
NEMABASE, Vers. 1	1995	

Books on IPM

Title	**Year published, year revised**	**Publication number**
Integrated Pest Management for Alfalfa Hay	1981, 1985	Publ. 3312
Integrated Pest Management for Walnuts	1982, 1987, 2003	Publ. 3270
Integrated Pest Management for Tomatoes	1982, 1989, 1990, 1998	Publ. 3274
Integrated Pest Management for Rice	1983, 1992	Publ. 3280
Integrated Pest Management for Citrus	1984, 1991	Publ. 3303
Integrated Pest Management for Cotton	1984, 1996	Publ. 3305
Integrated Pest Management for Cole Crops and Lettuce	1985	Publ. 3307
Integrated Pest Management for Almonds	1985, 2001	Publ. 3308
Integrated Pest Management for Potatoes	1986, 1992	Publ. 3316
Integrated Pest Management for Small Grains	1990	Publ. 3333
Pests of the Garden and Small Farm: A Grower's Guide to Using Less Pesticide	1990, 1998	Publ. 3332
Managing Insects and Mites with Spray Oils	1991	Publ. 3347
Integrated Pest Management for Apples and Pears	1991, 1999	Publ. 3340
Integrated Pest Management for Strawberries	1994	Publ. 3351
Pests of Landscape Trees and Shrubs	1994, 2004	Publ. 3359
Natural Enemies Handbook: An Illustrated Guide to Biological Pest Control	1998	Publ. 3386
Integrated Pest Management for Stone Fruits	1999	Publ. 3389
Integrated Pest Management for Floriculture and Nurseries	2001	Publ. 3402
IPM in Practice: Principles and Methods of Integrated Pest Management	2001	Publ. 3418
The Seasonal Guide to Environmentally Responsible Pest Mgmt. Practices in Almonds	2004	Publ. 21619

Other IPM publications

Title	**Year published**	**Publication number**
Natural Enemies Poster.	1990	Publ. 21496
Color Photo Guide to Sugarbeet Pests	1996	Publ. 3339PS1
Color Photo Guide to Dry Bean Pests	1996	Publ. 3339PS2
Color Photo Guide to Onion/Garlic Pests	1997	Publ. 3339PS3
Tree Fruit Pest Identification and Monitoring Cards	2003	Publ. 3426

UC IPM Pest Management Guidelines (43 crops) Continuing series: first PMG published in 1987
Alfalfa, Almond, Apple, Apricot, Artichoke, Asparagus, Avocado, Bermudagrass Seed Production, Caneberries, Carrot, Celery, Cherry, Citrus, Cole Crops, Corn, Cotton, Cucurbits, Dry Bean, Fig, Floriculture and Ornamental Nurseries, Grape, Kiwifruit, Lettuce, Nectarine, Olive, Onion/Garlic, Peach, Pear, Pecan, Peppermint, Peppers, Pistachio, Plum, Potato, Prune, Rice, Small Grains, Spinach, Strawberry, Sugarbeet, Tomato, Turfgrass, Walnut

Pest Notes (110) Continuing series: first Pest Note published in 1995

Annual Bluegrass, Publ. 7464	Dodder, Publ. 7496
Anthracnose, Publ. 7420	Drywood Termites, Publ. 7440
Ants, Publ. 7411	Earwigs, Publ. 74102
Aphids, Publ. 7404	Elm Leaf Beetle, Publ. 7403
Apple Scab, Publ. 7413	Eucalyptus Longhorned Borer, Publ. 7425
Bark Beetles, Publ. 7421	Eucalyptus Redgum Lerp Psyllid, Publ. 7460
Bed Bugs, Publ. 7454	Eucalyptus Tortoise Beetle, Publ. 74104
Bee and Wasp Stings, Publ. 7449	Field Bindweed, Publ. 7462
Bermudagrass, Publ. 7453	Fire Blight, Publ. 7414
Bordeaux Mixture, Publ. 7481	Fleas, Publ. 7419
Boxelder Bug, Publ. 74114	Flies, Publ. 7457
Brown Recluse and Other Recluse Spiders, Publ. 7468	Fruittree Leafroller on Ornamental and Fruit Trees, Publ. 7473
California Ground Squirrel, Publ. 7438	Fungus Gnats, Shore Flies, Moth Flies, and March Flies, Publ. 7448
California Oakworm, Publ. 7422	Giant Whitefly, Publ. 7400
Carpenter Ants, Publ. 7416	Glassy-winged Sharpshooter, Publ. 7492
Carpenter Bees, Publ. 7417	Grasshoppers, Publ. 74103
Carpenterworm, Publ. 74105	Green Kyllinga, Publ, 7459
Carpet Beetles, Publ. 7436	Hackberry Woolly Aphid, Publ. 74111
Clearwing Moths, Publ. 7477	Head Lice, Publ. 7446
Cliff Swallows, Publ. 7482	Hobo Spider, Publ. 7488
Clothes Moths, Publ. 7435	Hoplia Beetle, Publ. 7499
Clovers, Publ. 7490	Horsehair Worms, Publ. 7471
Cockroaches, Publ. 7467	House Mouse, Publ. 7483
Codling Moth, Publ. 7412	Kikuyugrass, Publ. 7458
Common Knotweed, Publ. 7484	Lace Bugs, Publ. 7428
Common Purslane, Publ. 7461	Lawn Diseases, Publ. 7497
Conenose Bugs, Publ. 7455	Lawn Insects, Publ. 7476
Cottony Cushion Scale, Publ. 7410	Leaf Curl, Publ. 7426
Crabgrass, Publ. 7456	Lizards, Publ. 74120
Creeping Woodsorrel and Bermuda Buttercup, Publ. 7444	Lyme Disease in California, Publ. 7485
Dallisgrass, Publ. 7491	Millipedes and Centipedes, Publ. 7472
Dandelions, Publ. 7469	Mistletoe, Publ. 7437
Deer, Publ. 74117	Moles, Publ. 74115
Delusory Parasitosis, Publ. 7443	Mosquitoes, Publ. 7451

Mushrooms and Other Fungi in Lawns, Publ. 74100 Nematodes, Publ.7489 Nutsedge, Publ. 7432 Oak Pit Scales, Publ. 7470 Oleander Leaf Scorch, Publ. 7480 Olive Fruit Fly, Publ. 74112 Pantry Pests, Publ. 7452 Perennial Pepperweed, Publ. 74121 Pitch Canker, Publ. 74107 Plantains, Publ. 7478 Pocket Gophers, Publ. 7433 Poison Oak, Publ. 7431 Powdery Mildew on Fruits and Berries, Publ. 7494 Powdery Mildew on Ornamentals, Publ. 7493 Powdery Mildew on Vegetables, Publ. 7406 Psyllids, Publ. 7423 Rabbits, Publ. 7447 Raccoons, Publ. 74116 Rats, Publ. 74106 Rattlesnakes, Publ. 74119 Redhumped Caterpillar, Publ. 7474 Red Imported Fire Ant, Publ. 7487 Roses in the Garden and Landscape: Cultural Practices and Weed Control, Publ. 7465 Roses in the Garden and Landscape: Diseases and Abiotic Disorders, Publ. 7463 Roses in the Garden and Landscape: Insect and Mite Pests and Beneficials, Publ. 7466	Russian Thistle, Publ. 7486 Scales, Publ. 7408 Scorpions, Publ. 74110 Sequoia Pitch Moth, Publ. 7479 Silverfish and Firebrats, Publ. 7475 Skunks, Publ. 74118 Snails and Slugs, Publ. 7427 Sooty Mold, Publ. 74108Spider Mites, Publ. 7405 Spiders, Publ. 7442 Spotted Spurge, Publ. 7445 Sudden Oak Death in California, Publ. 7498 Sycamore Scale, Publ. 7409 Termites, Publ. 7415 Thrips, Publ. 7429 Voles (Meadow Mice), Publ. 7439 Walnut Husk Fly, Publ. 7430 Weed Management in Landscapes, Publ. 7441 Weed Mgmt. in Lawns, Publ. 74113 Whiteflies, Publ. 7401 Wild Blackberries, Publ. 7434 Windscorpion, Publ. 7495 Wood-boring Beetles in Homes, Publ. 7418 Wood Decay Fungi in Landscape Trees, Publ. 74109 Wood Wasps and Horntails, Publ. 7407 Yellowjackets and Other Social Wasps, Publ. 7450 Yellow Starthistle, Publ. 7402

CD-ROMs

Title	**Year published**	**Publication number**
The UC Guide to Solving Garden and Landscape Problems	2000	Publ. 3400.
The UC Interactive Tutorial for Biological Control of Insects and Mites	2001	Publ. 3412.

Pesticide safety and training books

The Safe and Effective Use of Pesticides	1988, 2000	Publ. 3324
Residential, Industrial, and Institutional Pest Control	1991	Publ. 3334
The Illustrated Guide to Pesticide Safety, *Guía ilustrada para el uso seguro de pesticidas*		
Worker's Edition	1991, 1998	Publ. 21488
Instructor's Edition	1991, 1999	Publ. 21489

Punjabi Worker's Edition:	1998	Publ. 21488P
Wood Preservation.	1992	Publ. 3335
La lotería de los pesticidas.	1994	Publ. 3355
Forest and Right-of-Way Pest Control.	1995	Publ. 3336
Jorge's New Job: Getting Tested for Cholinesterase; *Un nuevo trabajo para Jorge: el análisis de la colinesterasa.*	1995	Publ. 21507
Pesticide Safety—A Reference Manual for Private Applicators.	1997, 1999	Publ. 3383
La seguridad en el manejo de pesticidas—manual de referencia para aplicadores privados.	1999	Publ. 3394 (Spanish Vers. of Publ. 3383)
Aquatic Pest Control.	2001	Publ. 3337
Demonstration and Research Uses of Pesticides.	2003	Publ. 9001 (available online only)

Videos

Jorge's New Job: The Importance of Cholinesterase Testing. English: V94-W; Spanish: V94-X; English and Spanish: V94-WW
Long-Term Health Effects of Pesticide Exposure. V94-O
Pesticide Safety in the Greenhouse. V86-AJ; Spanish: V86-AK
Pesticide Safety for Small Farms. English: V96-A; Spanish: V-97-H; Hmong: V96-B; Ilokano: V03-A
Safe Handling of Pesticides. V88-T; Spanish: V88-U
Safe Use of Pesticides and Disinfectants in the Poultry Industry. English: V89-AX; Spanish: V89-BF
Safe Use of Pesticides in Outdoor Nurseries: Part 1 and Part 2. English: V95-A; Spanish: V95-B; English & Spanish: V95-AB
Training Greenhouse Workers to Handle Pesticides Safely. V86-AL; Spanish: V86-AM; Japanese: V89-0

Annual reports

UC IPM Program: Annually since 1980
Exotic/Invasive Pests and Disease Research Program: Annually since 2002