A RATIONALE AND EXAMPLE

New Directions In Post-Baccalaureate Training For Pest Management and Plant Protection

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Abstract

The need for well trained crop protection practitioners is established; however, most curricula fail to produce students ready to make management decisions. We propose here a pest management program that would resolve many current problems in IPM education. Of central focus is a Land Laboratory, integrating practical experience with academic preparation.

Introduction

Probably no other subject has influenced trends in modern agricultural training and practice as much as has integrated pest management (IPM). Even a cursory review of the available literature (e.g., Smith and Pimentel 1978, Rabb and Guthrie 1970, Pimentel 1981a, b, c, Bottrell 1979, Metcalf and Luckmann 1975, Knipling 1979) focuses one immediately on the scientific community's concern with IPM. One can conclude only that the concepts of IPM will influence agricultural practices in the future.

While the above citations (and many others) elucidate the biological, ecological, and practical problems associated with the development and delivery of IPM technology, they do not address the details of how an IPM practitioner should be educated and trained if he/she is to be successful. The implicit assumption seems to be that students emerging from curricula at universities teaching IPM are ready to "do IPM." Our experience is that this assumption is not true, for at least two reasons. First, curricula in IPM usually omit sufficient rigor in non-commodity or non-control courses (e.g., population ecology, statistics) (see Barfield and Jones 1979). Thus students emerge from IPM programs knowing a lot of facts and few ways to apply them. Second, and even more of a problem, students have very brief exposure to the real world practice of IPM prior to graduation. Internships, while good in theory, are poorly administered since many times interns end up as "flunky labor" instead of participants in IPM decision-making. Besides that, the entire concept of merely one semester's (or quarter's) exposure as sufficient for an internship is startling. Imagine a medical doctor who must intern for only 3 to 4 months prior to being certified by the American Medical Association. Clearly, the agricultural community must rethink priorities for training crop protection personnel.

Integrated pest management/crop protection is defined as the selection, integration, and implementation of crop production and pest control tactics based on predicted economic, ecological, and sociological consequences (modified from Bottrell 1979). The need for and the effectiveness of integrated pest management tactics are well established, but training of practitioners lags well behind present and projected needs. Many land grant universities have responded with undergraduate and graduate programs in integrated pest management/crop protection. However, these programs usually do not provide sufficient practical experience nor are they sufficiently broad in scope. "Hands on" training experience is required at only about half the universities and colleges with pest management curricula. In most cases, where required, it is narrow experience with one or a few crops or tactics. This is so despite the fact that commodity production using integrated management principles realistically demands a broad background and many skills. These skills and background should all contribute to the primary objective, which is the ability to produce a commodity. Therefore, broad experiential learning should be an integral part of the crop protection practitioner's education. Second, most programs have evolved from traditional entomology and plant pathology lines and not from commodity production. Therefore, they do not offer broad enough bases of training.

The graduate level curriculum we propose would meet the needs of future crop protection practitioners by teaching crop production firsthand through the use of a student-managed land laboratory. The practitioner graduated from this program would be a well-rounded, broadly trained individual able to perform competitively in crop protection jobs in industry, extension, and the private sector.

The Problem

Why do we need to train pest management/crop protection practitioners (Good 1974, Sill 1978, Tammen and Wood 1977, Cox 1971, Andrews 1980)? Simply stated, a growing U.S. and world population demands

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more food to be produced on a finite land area in an ecologically safe manner. Despite the fact that pest management technology is not yet at an advanced state, significant results have been obtained through practice of this philosophy using present day knowledge (Smith et al. 1976, Bottrell 1979, Barfield and Stimac 1980, Office of Technology Assessment Vol. I, II 1979, CAST Report No. 93 1982). Many reasons support adoption of a new pest management graduate program. Some are summarized below.

Manpower Needs

A major limitation in the implementation of pest management and crop protection practices is lack of trained personnel in research, extension, the agricultural chemical industry, vocational and high schools, and agricultural consulting (Office of Technology Assessment 1979, Glass 1975, Tammen and Wood 1977, Apple 1974, Sill 1978). As IPM technology advances and grower acceptance increases, demand will increase both here and abroad (Tammen and Wood 1977). In their Report to the President, the Interagency IPM Coordinating Committee stated (Council on Environmental Quality 1980)

> **The continued development of IPM will depend on the availability of persons trained to function at all levels of IPM. . . The demand for trained personnel in IPM has increased dramatically in the public and private sectors. Full implementation of IPM depends on the development and availability of these personnel over the next 10 to 20 years. To satisfy increased demand for IPM personnel at the local level more universities should be encouraged to support interdisciplinary IPM training.**

This report recommended that USDA and other federal agencies, in conjunction with universities, continue to promote IPM instruction leading to baccalaureate and graduate degrees. These programs should include essential disciplinary and significant interdisciplinary components emphasizing systems science and ecology.

In 1977, the Cooperative Extension Service counted 1,120 persons working in crop and animal health. Part of this number was engaged in pest management activities. In addition, there are about 500 IPM consultants that work independently or for cooperatives (Bottrell 1979, Good 1977). The Office of Technology Assessment (1979) reported three independent approximations of the manpower needed to implement pest management on agricultural crops at the field level. The USDA/Science and Education Administration/Extension Service estimates the need for 3,600 private consultants by 1986. The Extension Committee on Organization and Policy (ECOP) Pest Management Planning Committee estimated 5,000 advisors. Finally, the National Agricultural Chemicals IPM Committee estimated that 7,600 to 10,600 supervisory personnel would be needed to implement IPM on cotton, corn, sorghum, soybeans, alfalfa hay, peanuts, rice, and commercial vegetables.

The 50 land grant institutions responding to a Resident Instruction Committee on Organization and Policy (RICOP) questionnaire in 1979 (unpublished) reported 70 Masters level graduates in Pest Management or Pest Management options in the academic year 1977-78. At this rate, by 1986 there will be an additional 560 Masters level professionals in pest management. Assuming no attrition of present workers, there will be (1,120 + 500 + 560) 2,180 persons involved in plant protection/pest management by 1986.

This number is far short of the 3,600-10,600 person estimates given above and does not include additional personnel needed for teaching pest management specialists. The responses to the RICOP questionnaire bear this out. Almost all schools report excellent job placement of graduates from pest management or crop protection-related curricula.

The Disciplinary Problem

The primary objective of pest management/crop protection is efficient crop production (Sill 1978, Office of Technology Assessment 1979, Apple and Smith 1976). The farm, or a whole geographic area, is the management unit. A grower is faced with decisions cutting across all the agricultural specialty areas. Extension personnel and consultants are therefore also faced with these same problems. The farm is not disciplinary so pest management/crop protection specialists should not be oriented along a single discipline.

The difficulties in working across traditional specialty disciplines is well documented (Sill 1978, Office of Technology Assessment 1979, Apple and Smith 1976). The disciplines are a necessary part of agricultural research and training, but at the field level and in forming truly integrated systems there must be multidisciplinary coordination and general practitioners.

Historically, agricultural universities have trained mostly along disciplinary lines. Therefore, there are few generalists. Why should there be? Researchers and educators are evaluated for promotion and tenure by their peers and/or department chairpersons on the basis of personal achievement in their specialty. Few people are paid to be cooperators as well as scientists (Barfield and Stimac 1980). "Problems of politics, power, credit, and control usually seem to rear their ugly heads" (Sill 1978). Complex research and teaching activities in pest management will require that these problems be worked out. Plant protection specialist training will have to be made non-disciplinary to produce needed generalists. Huffaker (1982) argues that each discipline involved cannot continue to go its own way; it is the whole production system that counts.

Urban Student Population

As smaller farms are consolidated and give way to larger, more mechanized operations, the pool of students from rural backgrounds with farm experience has decreased. Agricultural schools are faced with exposing many students to farm experience for the first time

or awarding agricultural degrees to persons without hands-on farm experience.

A 1977 survey by the Dean for Resident Instruction in the Institute of Food and Agricultural Sciences (IFAS) at the University of Florida revealed that 48.8% of agricultural majors and recent graduates had no farm experience (Fry 1977). Of the 52.2% with farm experience, 30% had only occasional summer experience. This leaves 63.4% with little or no experience. This study, however, did not explore degree of competence or range of skills of those with experience.

Extension

The Extension Service, created by the Smith-Lever Act (1914), had as its mission the dissemination of farm and home economics information from the land grant colleges. It is meant to link research and the grower. At the state level, it provides major planning and coordination and is involved with specific growers if special problems arise. At the county level, the agent usually is B.S. or M.S. trained in some general agricultural (e.g., animal science, agronomy) discipline, has direct contact with growers, and acts as a liaison and referral link between experts in specific fields and the farmers. Is the county agent effective in grower contacts with today's complex technology? In many instances, the county extension agent cannot meet the needs of the growers because use of new technology demands constant, expert and fast service (Coz 1971, Sill 1978), Pohronezny 1981). County extension agents usually are not broadly enough trained, have too much subject matter responsibility, and even on a referral basis cannot provide the necessary diagnoses and recommendations fast enough. Extension should still disseminate information and advice. However, the private consultants also should be clients of the extension agents. Since most "in service" training does not address these issues, retraining of the county agent may become necessary since what is needed at this level of grower service is a field-trained generalist, able to cope with a variety of problems.[1]

The Extension Service, therefore, may not meet all of the individual grower's demands for pest management technology, nor should they be expected to in a free enterprise agricultural system. In addition, extension personnel should be more broadly trained generalists to be able to function with the more complex pest management technology.

Industry

The agricultural chemical industry presently provides much of the advice to farmers concerning use of pesticides and control of pests. Although some contend that this is an excellent source of trained manpower to disseminate pest management information, many (Cox 1971, Sill 1978, Bottrell 1979) agree that there is an obvious conflict of interest. It is not possible to expect someone whose livelihood is pesticide sales to recommend ways not to use his product or to recommend a competitor's product, even if it is better. The pesticide industry should deal with agricultural consultants, not farmers.

Practitioner Perspectives

At the field level there is general agreement concerning the needs of agriculture for persons trained in pest management/crop protection. For purposes of sounding out our hypothesis, we interviewed persons involved in consulting, extension, and industry.

All had definite ideas about graduate education and there was consensus about the following points:

1. There is a need for generalists in agriculture that have holistic, general backgrounds.
2. University education that includes an internship or practical experience is important.
3. Students should get "hands-on" experience by actually growing crops.

Approaches

Individuals with broad interdisciplinary backgrounds are necessary for modern agriculture. In addition some sort of practical experience should be part of the specialist's training (Tammen and Wood 1977, Sill 1978, Pimentel 1970, Cox 1971).

The Resident Instruction Committee on Organization and Policy (RICOP) published their recommendations in "Systems of Pest Management and Plant Protection" (Browning 1972). Their suggested undergraduate coursework and internship are used as a basis for our thesis. In summary, the RICOP report suggests the choice of thesis or non-thesis would depend on the student's objectives and each graduate committee having members from Plant Pathology, Nematology, Entomology and Weed Science. Clinical experience is recommended as part of the program.

We favor a Masters training program as suggested by RICOP but intend that it not be disciplinary and that **field experience be its central theme.** Graduates of the program will be able to function as practitioners and consultants, thus perhaps eliminating the need for general Ph.D. level practitioners.

The Land Laboratory

The use of land laboratories in teaching agricultural techniques and farm management practices is not a new concept. Vocational agriculture schools, community colleges, and even secondary schools use school-run farms for teaching purposes. In 1969 California had 167 schools with school farm laboratories with a total of 2,584 acres (Juergenson and Dowler 1971). More than half the agricultural departments in Illinois now use some sort of school farm (Swanson and Tucker 1978). Duff (1970) relates that Florida was one of the pioneer states in the use of land laboratories and that their numbers are increasing.

[1] Observation by author Strayer who was Extension Entomologist, Pesticide Program Coordinator and District Extension Director for University of Florida 1965-76.

The need for practical experience in agricultural schools is clearly established because of a largely urban clientele. In spite of this, only a few universities have student-run farms as described above. **None** teach IPM or crop protection in this manner.

Proposed Curriculum

We propose a curriculum to provide a two year program resulting in a Master of Agriculture in Crop Protection degree. The central theme of the program is teaching efficient, environmentally safe, commodity production. Students will learn basic and applied sciences related to crop production and protection. Didactic studies will be a mixture of most teaching mechanisms that can and have been used (Schein 1972). The traditional disciplinary and integrated courses will be structured to best accommodate the seasonal nature of a farm schedule.

The land laboratory is the center of this holistic curriculum and training facility. To enhance intensive hands-on experience, the student will participate in the planning and production of various commodities. The laboratory farm will require 100-200 acres (min-max) of land suitable for agricultural development. This acreage is necessary to permit 5-10 acre fields as well as smaller experimental plots which will allow for varying cropping and rotational programs. Areas will be required for equipment storage, field teaching laboratories, greenhouses, and similar support facilities.

The immediate farming operation will be under the supervision of an individual trained and experienced in farming who is capable of interacting with students and student managers. The farm supervisor also will interact with the Teaching Committee and professors to synchronize the farm with requisite instructional needs. Innovative teaching techniques are available to make structuring of coursework around growing seasons possible (Schein 1972, Fisher 1976).

A frequent objection to the training of an agriculture generalist is that so many subject areas cannot be taught with any effectiveness. We disagree and feel it would be more effective to teach many subject areas under the controlled environment of the university land laboratory. The agricultural consultants to whom we have spoken agree that they are faced with learning other subject areas on the job anyway. This program will not be easy, but intensive, and probably of two plus years duration. It will require proper undergraduate preparation by hardworking intelligent students.

Curriculum

Prerequisites to the program should include or be equivalent to those courses required for a Systems of Pest Management and Plant Protection Specialist at the Univeristy of Florida (Strayer 1980). Strict adherence to these requirements and graduate school entrance requirements will be necessary for a student to enter the program.

No specific course of study will be required. The student and advisory committee will be expected to evaluate previous training and incorporate necessary training where applicable, and the student will register for the program instead of specified hours. Students will be expected to pass comprehensive final oral and written examinations which demonstrate their knowledge of soils, soil fertility, fertilizers, crop growth, abiotic effects on crop growth, plant-pest competition, pest population dynamics, pest recognition, crop and farm firm management, statistical and sampling techniques, pesticides, experimental design and analysis, agricultural mechanics, and agricultural laws. The core of the program will be composed of three courses.

(1) **Topics In Plant Production and Pest Management.**

These topics carry the option of being titled according to subject matter. They are designed to be innovative, including the various teaching mechanisms outlined by Schein (1972). These methods in most instances will be augmented by the use of computer aided and computer managed instruction. The topics courses will provide the basic and applied information to be used at the land laboratory. They may or may not be of traditional "term" duration, can focus on very specific topics, and may be taken as often as deemed necessary by the student or the advisory committee. Examples of subjects included will be growing of the crop, various varieties and cultivars, physiology, pests and abiotic factors affecting the crop, clinical overview of crop problems, and management of problems. The number of different courses is not limited and flexibility will allow dealing with field production problems on an immediate basis. Other examples of topics subjects are: farming systems, economics for pest management, role of computers and modeling for crop production and protection, and sampling pest populations.

(2) **Quantifying Plant-Pest Interactions.**

In this course students will learn the dynamics of how crops, populations of pest species, and physical environment interact. They will learn how to establish and analyze experimental designs to measure crop growth, pest population growth, and plant-pest competition. Students will be taught how extension and research activities interface in planning, development, and implementation of pest management programs.

(3) **Land Laboratory**

The land laboratory epitomizes the holistic approach for teaching crop production and protection. Students will learn sequences in crop production by being directly involved in each production practice from planning stages through harvest. This laboratory will be designed to integrate crop production and protection principles the student has obtained from academic study.

The key to the success of the program will be the integration of the laboratory with the other learning experiences. Students will obtain the requisite knowledge from the three core courses, enrollment in existing traditional courses, modification and development of existing coursework into audiotutorial (slide-tape) and computer aided instruction, seminars, land laboratory debriefing and discussions, term papers, and individual library research.

We expect a graduate of this program to be qualified to enter governmental services, industry or private employment as specialists to function in most

all of the positions described by RICOP in the report "Systems of Pest Management and Plant Protection" (Browning 1972).

While international program development is not a major objective of this program, a definite training opportunity may result from the establishment of this graduate program and its land laboratory. With proper coordination and support, the land laboratory will become a center for conducting educational programs and training of scientists from developing countries.

We feel the approach and curriculum outlined herein is innovative and conducive to preparing students for making effective inputs into crop production and protection. Problems focused upon are classical problems in academic institutions which are not easily resolved. Hopefully, we can make progress toward upgrading instruction in crop protection so as to provide the agricultural community with functional practitioners.

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A CASE STUDY

Ag Alumni Survey Depicts Undergraduate Educational Needs

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Abstract

Almost 50 percent of graduates responding to an alumni survey have completed some form of post-baccalaureate study. Fifty-two percent are currently employed in a job related to their undergraduate field of study. Thirty-five percent of those not employed in their field are still looking. About one-half the respondents felt that job opportunities in their field are fair to good. Alumni recommended additional courses be added to existing programs. Examples are speech, business, internship opportunities, and more courses with laboratories and field work.

The United States is undergoing demographic change. With the baby boom generation through college and the number of elementary school students declining a predicted drop in college enrollments is justified for 1985-1995. Estimates of this decrease range from 5 to 15 percent. In view of this, many colleges may have difficulty in the near future attracting and retaining sufficient numbers of students.

To better understand and meet the needs of our students, the College of Resource Development elected to conduct an alumni survey. A review of the literature showed no Ag Alumni surveys of the Northeast. A small scale survey was done by the College of Agriculture at Montana State University in 1979.[1]

Todays college student is very career oriented, and students graduating in the 1980's can expect to find fewer jobs. The student is, in fact, facing a formidable task. The Federal Government predicts that the number of college graduates entering the labor force between 1980 and 1990 will exceed the number of traditional jobs by 3 million.[2] In agriculture specifically, the USDA survey "Graduates of Higher Education in the Food and Agriculture Sciences" predicts job shortages in a number of areas. [3] Their projected estimates through 1985 of supply/demand for Ag graduates suggests shortages of jobs for media specialists and educators. In addition, supply approximates demand for agricultural production and management specialists.

Much of the effort in career development in agriculture has been accomplished through 4-H activities such as career camps.[4] Current publications often ignore or minimize agriculture and resource use. Mayhew[5] stated that most of the recommendations found in the contemporary literature either reiterate criticisms of the past, or offer no real help to those concerned with program development. Bentley[6] has pointed out the need for strengthening land grant colleges "in research, teaching, and extension work so they can execute both current and future agricultural programs."

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