

# **THE NORTH CAROLINA CENTER FOR INTEGRATED PEST MANAGEMENT**

## **INTRODUCTION**

Management of pest species in agricultural environments has become highly technical since the introduction of synthetic chemicals as pesticides. These chemicals have been used very successfully to replace man and machine power for the control of pest species, including insects, weeds, and plant and animal pathogens. Their use has contributed to the economic well-being of the chemical industry involved in their production as well as to the agricultural producers who use them. Pesticide sales in agriculture totaled over \$15 billion in The United States in 1988, and nearly \$2 billion of that was spent on industrial research and development efforts. Recent estimates indicate that 5 to 7 years and up to \$50 million are required to develop a chemical as a pesticide for agriculture before any sales occur. This high level of input requires that a high probability of success over a reasonable time period be anticipated before a company decides to pursue a new pesticide registration.

Although in many cases pesticides are the most efficacious and economical means of controlling a pest population, the most effective use of these chemical tools is in an integrated effort utilizing cultural, mechanical, and biological controls as well. This approach is referred to as Integrated Pest Management (IPM), and involves a basic understanding of pest biology coupled with choices of control technology resulting in the most economically sound, environmentally compatible, and sociologically responsible outcome. Judicious use of pesticides is an integral part of the IPM philosophy.

Recent public concern over environmental quality and food safety related to pesticide use has revealed a need for a more proactive role by agricultural scientists and other knowledgeable professionals in addressing these issues. Although much of this concern may be the result of over-dramatization in news accounts, there certainly are real issues relating to pest management which need to be addressed. For instance, there are documented cases of contamination of ground and surface water from pesticides not directly identifiable with point sources. Pesticide residues in food products are being questioned, even though they are within EPA standards. Species of several different pest classes have been documented as having developed resistance to commonly used pesticides. Although none of these circumstances would be judged by experts to be generally unresolvable issues, they are, nevertheless, cause for concern. These and other similar matters must be dealt with in order to clear the record and set the course for future pest management practices. We must make sure that the leadership in development and implementation of pest management programs is provided by those trained in agricultural and the environmental science, and not by those using fear and sensationalism to persuade political decision makers.

### **CENTER GOAL**

The goal of the Center for Integrated Pest Management (CIPM) will be to serve the lead role in technology development, program implementation, training, and public awareness for IPM at the state, regional, and national level. The CIPM will be an organizational unit within the College of Agriculture and Life Sciences at North Carolina State University. It will be composed of faculty members from all academic departments in the College and will involve all relevant disciplines impacting on IPM. As the need arises, the CIPM may also

involve scientists from other universities across the nation through grants, contracts, or other formal working relationships.

North Carolina State University has a history of commitment to industrially relevant research and implementation programs. The University has made the expertise of its faculty available to industry through classroom training and short courses, Extension Service interactions, research contracts, and various consulting arrangements. In addition, several industry scientists hold adjunct appointments with the University. The development of CIPM is an extension of this effort.

## **RESEARCH FOCUS**

1. Impact of pest management on environmental quality. Research will be conducted to define the parameters that are important in determining the environmental impact of pest management practices. Once the appropriate factors have been identified and their importance ranked in some quantifiable manner, models can be developed to predict the potential impact of pest management decisions, thus helping to avoid mistakes that might be made otherwise.
2. Crop loss assessment and economic threshold determinations. Ability to accurately assess potential crop losses from pest outbreaks is a cornerstone to successful IPM practice, allowing growers to use pesticides when justified economically. Another, and perhaps more immediately compelling reason for having accurate crop loss assessment capability is the necessity for this information in risk/benefit analyses conducted by EPA in pesticide re-registration decisions.
3. Genetic engineering for improved pest management. Recent advances in

biotechnology, especially the ability to rapidly manipulate genetic traits among species, offer great potential in many areas of IPM. The possibility of increased pest resistance in crop plants and livestock, as well as vastly improved biological control agents will be high priority research areas.

4. Improved understanding of pest biology and ecology. Proper management of many crop and livestock pests depends on the ability to predict if and when the pest species will occur and cause a problem. Research designed to better understand pest species biology will aid in the development of more specific management options with fewer off target effects.
5. Pesticide resistance detection and management. Pesticides are, and will continue to be in the foreseeable future, a major pest control tactic. One of the most common reasons many pesticides, especially insecticides, cease to be used is because the target pest develops resistance to the chemical. Research programs designed to understand pesticide resistance both at the molecular level and at the pest population level will help delay or even avoid the phenomenon.
6. Development of decision support systems for IPM. IPM decision makers, whether they be farmers, consultants, extension agents, or part of the chemical distribution network, are faced with making complex decisions with grave economic consequences. Many times the inputs for making a good decision are so numerous that it is not humanly possible to take all of them into account. The development of affordable computer technology has taken IPM decision making to a higher precision level by providing the speed of computation necessary to not only take all the detail into account, but to

evaluate several scenarios affecting the same decision. Development of decision support software for IPM will be a major component of the CIPM, with expertise from all areas of the Center cooperating in this development.

## **ORGANIZATIONAL STRUCTURE**

The organizational structure of CIPM will include a Center Director, an Academic Policy Committee to ensure compliance with all University guidelines, an Industrial Advisory Board to review projects and present industry viewpoints to the Center, an on-campus NSF evaluator, and project managers for each area of research concentration (Figure 1).

**DIRECTOR:** The Center Director will have administrative responsibility for operation of CIPM, including policy decisions, selection of research projects, budgeting and administration of CIPM funds, and day-to-day activities of the Center. The Director will work with the Industrial Advisory Board, the Academic Policy Committee, and Center faculty to identify key areas of research interest and to establish short- and long-range goals and objectives for CIPM. A major responsibility will be to act as the primary liaison with participants and to seek new participants.

The Center Director will be Dr. Harold D. Coble, a weed scientist in the Crop Science Department. Dr. Coble is a tenured full professor with 21 years experience on the faculty. He has been involved in IPM research, education, and implementation projects at the state, national, and international level, and served as an objective leader in administration of the USEPA- and USDA-funded Consortium for Integrated Pest Management. During the past 21 years, Dr. Coble has actively cooperated with various industrial organizations, and has received over \$1,000,000 in industry support for his research during that period. He also has

served as a consultant to the major agricultural chemical companies on issues relating to IPM and pesticide use.

**ACADEMIC POLICY COMMITTEE:** The Academic Policy Committee (APC), chaired by the Vice Chancellor for Research, will be composed of Associate Deans and Department Heads from academic units involved in CIPM. This committee will assure that CIPM activities meet University criteria for scientific and academic pursuits.

**INDUSTRIAL ADVISORY BOARD:** Each organization participating in CIPM will be given a seat on the Industrial Advisory Board (IAB) with one vote. The IAB members will meet semi-annually to review Center programs and make recommendations relative to Center operations. The Board will review all research proposals and make funding recommendations, review progress on funded projects, review operating and research budgets, and give council on policy.

**NSF EVALUATOR:** The Center is being organized with initial funding and guidance from the National Science Foundation and their Industry/University Cooperative Research Centers Program. During the period of National Science Foundation support, there shall be an NSF Evaluator, compensated by the Center, to evaluate the activities of the Center and report, at appropriate intervals, to the National Science Foundation. The Evaluator shall have access to all records, to all personnel of the Center, and to individual sponsors.

**CENTER FACULTY MEMBERS:** Members of the Center will be University faculty or research personnel. They will be appointed by the Director, with the concurrence of the Dean of the College of Agriculture and Life Sciences and the Chairpersons of the faculty members' respective academic departments. In addition to faculty members, the Center may have a

professional and administrative staff as needed. Resumes of Center Faculty are included in the appendix.

## **CENTER POLICIES**

Companies having U.S. operations and government research organizations may become sponsors of the Center. A sponsor will have privileges relating to participation in research activities of the Center, to early access to research results, and to participation in the direction of the research program in return for financial support for the Center. A draft copy of the sponsorship agreement is included in the appendix. Specific policies regarding publications and inventions are summarized below.

### **Publications**

The University reserves the right to publish, in scientific journals, the results of research by the Center. Manuscripts shall be submitted to Center sponsors by registered mail, with return receipt, at least 30 days before submission to a scientific journal. During the 30-day period following the receipt of the manuscript, a sponsor may request a delay in submission of up to six (6) months. Such a request shall be made in writing, giving justification for the request.

### **Patents and Other Intellectual Properties**

All patents and other intellectual property rights (hereinafter called "inventions" which shall include but not be limited to rights in inventions, patent applications, patents, and copyrights) on inventions conceived and first reduced to practice in the course of research funded by the Center shall be solely owned by the University. The University agrees to grant a non-exclusive royalty-free license to use any of the inventions to each of said sponsors. As

regards any license by the University, the sponsor shall have the right to grant under the same terms a sublicense to its subsidiaries and affiliates required to be licensed by the sponsor's license agreement.

### **Industrial Participation**

The Center has received six (6) letters of commitment from major industrial and government organizations to participate as Sponsors of the Center. The annual fee is \$50,000.00 and an initial commitment of three (3) years has been approved. The commitment letters are included in the appendix. The IBM Corporation is participating as a sponsor by providing computer equipment in lieu of cash. This arrangement has been approved by the Industry Advisory Board. Three additional firms have verbally agreed to become sponsors during the first year of operation, but have not submitted letters.

### **RESEARCH PLAN**

A planning meeting of the Center faculty was held in January 1990 to identify key research and implementation areas. Groups of Center faculty then submitted pre-proposals to a faculty committee. Forty preproposals were reviewed by the faculty committee and 20 were selected for full proposal development. At the first planning conference of the Industry Advisory Board, these proposals were presented by faculty, and 12 were selected for further consideration. Of the 12 proposals to be considered further, five to seven will probably be funded by the Center. The 12 proposals receiving strong recommendation are listed below, together with the principal investigators. A summary of each proposal is included in the appendix.

## Topics for Center Funding

- \*1 "Integrated Decision Aid for Multi-Crop Pest Management" G. G. Wilkerson, S. A. Modena, H. D. Coble, J. R. Bradley, & H. J. Gold
- \*2 "Integrated Pest Management Training and Demonstrations for Extension Agents, Farmers, and Agri-business professionals" H. M. Linker, A. C. York, E. J. Dunphy, J. R. Anderson, J. P. Zublena, G. A. Sullivan, J. E. Bailey, J. W. Van Duyn, & R. L. Brandenburg
- \*3 "The Combined Efficacy of Bioengineered Pesticidal Plants and Natural Enemies" F. L. Gould, E. P. Lampert, & R. E. Stinner
- \*4 "A Study of Multiple Stress Factors and Their Interactions in Row Crops" J. R. Bradley, J. W. Van Duyn, H. D. Coble, & A. C. York
- \*5 "Mechanistic Modeling of Yield Loss in Wheat Infected with Powdery Mildew and Leaf Rust and Determination of Yield Returns of Flusilazole Sprays, Triadimefon Seed Treatment and Resistant Cultivars" K. L. Everts & Steven Leath
- \*6 "Runoff Potential and Chemical Transport in Relation to Tillage System" M. G. Wagger, J. B. Weber, T. J. Sheets, & R. B. Leidy
- 7 "Molecular Genetic Analysis of Bacteriocin Production by Pseudomonas solanacearum" P. B. Lindgren & E. A. Wernsman
- 8 "Production and Testing of Transgenic Peanut Lines with Enhanced Resistance to Aspergillus Species" A. K. Weissinger & G. A. Payne
- 9 "Integration of Chemical and Biological Control on Tomatoes" J. F. Walgenbach & E. A. Estes
- \*10 "Novel Assay for Monitoring Insecticide Resistance in Lepidopterous Pests" G. C. Rock, R. M. Roe, W. C. Dauterman, F. L. Gould, & C. Brownie
- 11 "Implementing and Integrated Pest Management Project for Turfgrasses in North Carolina" A. H. Bruneau, C. H. Peacock, R. L. Brandenburg, W. M. Lewis, & L. T. Lucas
- 12 "Integrated Control of Sclerotium rolfsii on Vegetable Crops using Soil Solarization and Biological Control" J. B. Ristaino, K. B. Perry, & E. Estes

## EVALUATION PLAN

The Industry/University Cooperative Research Center/NSF Evaluation Tasks are to be completed by the NSF Evaluator. Specific evaluation tasks to be performed by the NSF Evaluator include, but are not necessarily limited to, the following:

- a. Writing a history of the Center, including the planning period
- b. Administering, interpreting, and reporting a common set of questionnaires to selected Center participants such as the Director, the Industrial Advisory Board, Center Faculty, Students, and University Administrators
- c. Conduct and report "Exit Interviews" with sponsors withdrawing support
- d. Meet with Center Director and University Policy Committee and advise the Center where indicated
- e. Attend Industrial Advisory Board meetings
- f. Communicate with NSF relative to Center needs, concerns, and questions
- g. Attend and participate in NSF Evaluator meetings

The Center recommends Dr. Denis Gray to the National Science Foundation as the NSF Evaluator for the Center. Dr. Gray is a member of the faculty of the Department of Psychology at N. C. State University has been the NSF Evaluator for the I/UCRC Center for Signal Processing and the I/UCRC Center for Aseptic Packaging and Processing on the N. C. State University Campus. We believe he is well qualified to carry out the duties as the Evaluator.

## Budget

The total budget request to NSF is \$250,000 over five years to support the administrative and evaluation activities of the Center. Research and implementation activities in the Center will be funded from annual sponsorship fees. The projected number of sponsors and fees are as follows:

<u>Year</u>	<u>Number of sponsors and level</u>	<u>Annual sponsorship fee income</u>
1991	6 at \$50,000	\$300,000
1992	8 at \$50,000	\$400,000
1993	9 at \$50,000	\$450,000
1994	10 at \$50,000	\$500,000
1995	10 at \$50,000	\$500,000

## FIRST YEAR BUDGET

	NSF	Other	Total
A. Salaries and Wages			
Project Director, 50%	10,000.00	30,000.00	40,000.00
Staff Support	9,000.00	0	9,000.00
NSF Evaluator	<u>5,000.00</u>	<u>0</u>	<u>5,000.00</u>
Total Salaries and Wages	24,000.00	30,000.00	54,000.00
B. Fringe Benefits (23.9%)	5,736.00	7,170.00	12,906.00
C. Travel	4,048.00	0	4,048.00
D. Other Direct Costs			
Materials and Supplies	0	3,000.00	3,000.00
Publication Costs	0	1,500.00	1,500.00
Communications	0	1,000.00	1,000.00
Research Projects	0	225,900.00	225,900.00
Reserve	0	31,430.00	31,430.00
Total Other Direct Costs	0	262,830.00	262,830.00
E. Total Direct Costs	33,784.00	300,000.00	333,784.00
F. Indirect Costs	<u>16,216.00</u>	<u>0</u>	<u>16,216.00</u>
G. Total amount for first year	50,000.00	300,000.00	350,000.00

## FIVE-YEAR BUDGET DETAILS

	Year 1			Year 2			Year 3			Year 4			Year 5		
	NSF	OTHER		NSF	OTHER		NSF	OTHER		NSF	OTHER		NSF	OTHER	
<b>A. Salaries and Wages</b>															
Project Director (50%)	10,000	30,000		10,500	31,500		11,000	33,000		11,500	34,500		12,000	36,000	
Staff Support	9,000	0		9,000	0		9,000	0		9,000	0		9,000	0	
NSF Evaluator	5,000	0		5,000	0		5,000	0		5,000	0		5,000	0	
<b>Total Salaries and Wages</b>	<b>24,000</b>	<b>30,000</b>		<b>24,500</b>	<b>31,500</b>		<b>25,000</b>	<b>33,000</b>		<b>25,500</b>	<b>34,500</b>		<b>26,000</b>	<b>36,000</b>	
<b>B. Fringe Benefits (23.9%)</b>	5,736	7,170		5,855	7,528		5,975	7,887		6,095	8,245		6,214	8,604	
<b>C. Travel</b>	4,048	0		3,429	0		2,809	0		2,189	2,000		1,570	3,000	
<b>D. Other Direct Costs</b>															
Materials and Supplies	0	3,000		0	3,000		0	3,000		0	4,000		0	4,000	
Publication Costs	0	1,500		0	2,000		0	2,000		0	2,000		0	2,000	
Communications	0	1,000		0	1,000		0	1,000		0	1,500		0	1,500	
Research Projects	0	225,900		0	309,700		0	351,600		0	393,500		0	393,500	
Reserve	0	31,430		0	45,272		0	51,513		0	54,255		0	51,396	
<b>Total Other Direct Costs</b>	<b>0</b>	<b>262,830</b>		<b>0</b>	<b>360,972</b>		<b>0</b>	<b>409,113</b>		<b>0</b>	<b>455,255</b>		<b>0</b>	<b>452,396</b>	
<b>E. Total Direct Costs</b>	<b>33,784</b>	<b>300,000</b>		<b>33,784</b>	<b>400,000</b>		<b>33,784</b>	<b>450,000</b>		<b>33,784</b>	<b>500,000</b>		<b>33,784</b>	<b>500,000</b>	
<b>F. Indirect Costs</b>	16,216	0		16,216	0		16,216	0		16,216	0		16,216	0	
<b>G. Total Amount</b>	<b>50,000</b>	<b>300,000</b>		<b>50,000</b>	<b>400,000</b>		<b>50,000</b>	<b>450,000</b>		<b>50,000</b>	<b>500,000</b>		<b>50,000</b>	<b>500,000</b>	