

Actions Needed to Improve Crop Protection in the United States

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In view of the facts that pests collectively deprive the world of nearly one-half of the food man attempts to produce, that many present control strategies are in trouble that some pesticides have reduced effectiveness against many pests that support for the development of pest resistance is declining for some crops, and that there are still undetermined risks involved in pesticide use both to health and the environment, it is imperative that Congress examine its commitment to improve crop protection capabilities and reduce risks. Statistics recently compiled by the U.S. Department of Agriculture (USDA) indicate that, in spite of the substantial funding and science years (SYs) spent on crop protection the effort directed toward integrated pest management (IPM) is relatively small. The total USDA expenditure for crop protection in 1977 was million of this total \$81.3 million for USDA Agricultural Research (AR), and \$110.3 million was for State research. The USDA breakdown of the total is: basic research, 41 percent; control component research, 52 percent; 1PM systems research—control tactics and management 6.4 percent ,

Thus, it is evident that the major present effort in both Federal and State crop protection is devoted to basic and component research and very little to the integration of control tactics into management programs as part of total crop production systems. Under the existing mode of operation, it is the farmers who integrate the control tactics into, their production system and they must do this mostly by trial and error without the benefit of carefully conducted research to show the positive and negative interactions that may occur.

The simple solution of transferring significant proportions of present efforts from basic and control components research to 1PM systems research is not a viable option based on the results of the seven regional cropping systems studied. The development of 1PM systems requires additional basic knowledge about pests and crops as well as an extensive array of suitable management tactics. The situation has been compounded during the past decade by reduced funding (in terms of 1969 dollars). The traditional compartmentalization of crop protection programs according to disciplines has been very effective for basic and control component efforts but poses difficulties for developing interdisciplinary teaching, research, and extension

programs. When additional funding for such efforts is minimal, temporary, or nonexistent, it is most difficult to mount new programs without jeopardizing essential ongoing efforts. An infusion of new funding is essential for success.

The basic policy judgment that Congress faces is whether to commit the resources required to increase the speed of adoption of 1PM systems. The specific options chosen will indicate the level of commitment to this approach. The degree to which the needed actions are carried out will affect the time frame within which 1PM achieves its full potential:

1. At the present level of commitment, the status of crop protection would be maintained as primarily therapeutic responses to single-pest outbreaks for the immediate future. The already-limited range of available control tactics would be reduced even further as regulations regarding the use of chemical pesticides and resistance to them remove essential control tactics without replacement. The evolutionary shift to 1PM is too slow to have a significant impact except in a few situations.
2. A moderate increase in commitment would augment the present teaching, research, and extension programs to the extent that 1PM could eventually replace most unilateral pest control programs over the next two or more decades.
3. A major thrust over the next few years to remove the obstacles to the implementation of 1PM would enable much of the potential of 1PM to be realized within 15 years. An unparalleled portion of U.S. agricultural potential production could be achieved under 1PM while providing

maximum protection to man and the environment.

The technological and administrative obstacles to the implementation of 1PM are detailed in chapter V. Among the actions considered in this report for the removal of those obstacles, two emerge as indispensable at any level of commitment to 1PM. These are to:

1. Provide means to expand the knowledge base and the range of control tactics through basic research and to increase the pool of skilled manpower through expanded training programs.
2. Establish a clear focus of Federal intent and assign to USDA, the lead agency, the responsibility, authority, and necessary funding to coordinate research programs and to implement an adequately staffed and coordinated information delivery system.

The details of these actions are presented below and, although they correspond to the specific constraints identified in chapter V, they must be considered collectively to be effective. More complete discussions are in volume 11 (National Constraints).

EXPAND THE KNOWLEDGE BASE FOR PEST MANAGEMENT

Federal support of agricultural research in terms of real 'dollars has declined over the past 38 years. During this period the States have been hard pressed to meet the land grant universities' needs for facilities and staff required to accommodate an increased student load. This has resulted in reduced research efforts, including those on basic and applied crop protection. At present there are no significant opportunities to reallocate research funds and personnel from other activities to pest management programs. The USDA's AR is in a similar situation because of recent personnel ceilings and budgetary problems.

1PM research must of necessity involve considerable disciplinary and interdisciplinary efforts. These require extra time, ef-

fort, and resources. A favorable climate and incentives for such efforts must be present to ensure adequate cooperation among scientists.

Funds for Disciplinary and Interdisciplinary Research

Congress could increase the basic knowledge of pest and pest complexes by designating certain research funds specifically for disciplinary and interdisciplinary studies in the four major protection disciplines (entomology, weed science, plant pathology, and hematology) and for other studies such as vertebrate pests. Funds are also needed to support work in other disciplines such as economics, agronomy, and agricultural engineer-

ing which can make significant contributions to pest management programs.

To promote interdisciplinary efforts, it is essential that the continuing needs for basic new knowledge within disciplines should not be ignored. Such knowledge will form the basis for future advances in pest management. Adequate funding in the USDA competitive grants program for the area of plant stress can ensure that new and imaginative basic research will be undertaken.

Attention should be paid to the distinction between designating existing funds and allocating funds for specific projects. If existing funds are designated for interdisciplinary research, it may be necessary to terminate ongoing vital disciplinary research. Additional funds are necessary to allow the initiation of new projects by new researchers not tied to existing programs.

Long-Term Support for Pest Management Research

If pest management is to have top priority nationally, it must be given long-term continuing support. This need is highlighted by the continuing and changing nature of crop protection problems and available control tactics that require continual study and updating.

To help solve this problem, Federal funds for pest management research should be made available on a more long-term basis for facilities and tenured staff. This would provide pest management with the solid base necessary to its future success. The mechanism to achieve this is to assign funding for pest management research in the budget of USDA's Science and Education Administration (SEA)/AR, and SEA/Cooperative Re-

search (CR). Increased support through Hatch Act funding of SEA/CR with the specific intent of Congress will provide the most productive returns per dollar invested not only because of the efficiency of this partnership program but because in this funding mechanism no overhead is charged and each Federal dollar is matched with 3 to 4 State dollars. Research areas most in need of support and scientific manpower requirements are discussed in chapter IV.

Reallocation of Funds From Unfeasible Eradication Programs

Certain eradication programs are not considered to be feasible. After a careful review of the merits of these programs on a case-by-case basis by an impartial review body, Congress could discontinue those judged to be unworthy on the basis of cost/benefit ratios and probabilities for success. The funds could be reallocated to projects considered to be more productive in terms of preventing pest-induced crop losses. An obvious exception is the Plant Quarantine Act, which actually needs greater financial and professional support.

Peer Recognition

The rewards currently given a scientist who makes a major breakthrough are usually meager. Congress could help advance technical development in pest management tactics and systems through a program that would recognize scientists and groups responsible for major breakthroughs. By instituting such a program, Federal and State researchers would be provided with an extra incentive to pursue new and innovative directions in pest management research.

INCREASE THE RANGE OF AVAILABLE CONTROL TACTICS

Integrated pest management is an ecological approach to crop protection that involves the coordinated use of two or more tactics to prevent pests from causing intolerable losses. Sometimes management can be obtained by

simply changing some cultural operation and using a selective pesticide. More often, however, an array of tactics is needed including pest-resistant crops, modified cultural practices, biological control, and pesticides with

certain ranges of activity. A suitable array of tactics is essential for the formulation and implementation of pest management systems.

Increased Support for and Reorganization of Biological Control Efforts

"Classical" biological control (importation and establishment of exotic control agents such as parasites, predators, antagonistic micro-organisms, and other microbial) is an important tactic in pest management. The potential benefits apply more to insects and mites than other pests, but there are excellent examples of biological control of vertebrate pests, weeds, and plant pathogens. The payoff for success can be tremendous. The means for increasing the effectiveness of Federal and State biological control efforts are both quantitative and qualitative. Increased funding, with adequate consideration for the devalued dollar overseas, will enable needed increments in biological control exploration, importation, and distribution programs for beneficial species. The potential benefits of increased funding are about 30 to 1 based on past experience. The major negative aspect appears to be the cost, which is small compared to expected benefits. As part of this, adequate funding should be included to ensure that introduced beneficial are environmentally safe and effectively distributed by State and Federal agencies. Other means of enhancing biological control efforts relate to possible changes in the approaches used in Federal and State programs. The present Federal horizontal structure could be modified to a centrally organized, vertically structured unit. Instead of foreign field laboratories with a staff involved only in exploration, a field biologist would be intimately involved in all phases [exploration, importation, distribution] of the program. The advantage of this approach is that one person would be familiar with all aspects and requirements of the operation and would most likely succeed in finding and establishing biological control agents. Also, a national biological control planning body with more even representation among AR, CR, the Extension Service (ES), the

Animal and Plant Health Inspection Service (APHIS), the Forest Service (FS), and the States than exists on the current AR working group should be established to plan and evaluate programs, set priorities for project activities and support, and coordinate State and Federal efforts.

The emphasis placed here on the "classical" approach is not intended to imply that other approaches to biological control, such as parasite and predator augmentation, are not important; these need continued support.

Increased Support for Host-Plant Resistance

The incorporation of pest resistance into agricultural crops was identified as a vast promising approach to reduce both losses caused by pests and dependence on pesticides. One of the major reasons for serious pest problems is that many of our crop cultivars have been selected primarily for improved agronomic and esthetic characteristics without adequate regard to incorporating resistance to pest attack. One of the advantages of pest-resistant crops is that they are inexpensive for the producer, whether large or small, as well as for the home gardener. The cost of the lengthy process of finding genetic sources of resistance and moving them through to the end product of agronomically acceptable crop cultivars is high. As noted earlier, the private sector has not always been effective in this area, and public sector support is necessary. The cost/benefit ratio in terms of direct economics as well as in terms of human health and environmental considerations is judged to be favorable. The long-term benefits provided by pest-resistant varieties should far outweigh costs involved. (In the case of Hessian fly, wheat stem sawfly, European corn borer, and spotted alfalfa aphid, the net return for each dollar invested was \$30 per year or \$300 over a 10-year period in reduced crop losses alone.)

Increased Flexibility in Pesticide Use

The need to tailor pest management programs to local conditions requires the flexible

use of tactics in putting a program together. Until the passage of the 1978 Amendments to the Federal Insecticide, Fungicide, and Rodenticide Act, flexibility of pesticide use was limited by labeling—not only on maximum but also on minimum usage. Now pesticides can be used against unnamed pests, at lower than label dosages, and in novel ways on crops for which registrations exist. Flexibility would be increased further by reducing the turn-around time for applications to amend pesticide labels, or by allowing the States flexibility under section 24(c) to permit labeling to be accepted, printed, and used in the States if it does not vary appreciably from the original label.

incentives for the Development of Low-Sales=Volume, selective Pesticides

General agreement exists among crop protectionists that narrow-spectrum, or selective, pesticides are essential to the development of fully integrated pest management programs. Such pesticides include the so-called “third-generation pesticides”—pheromones, hormones, bacteria, and viruses. The barriers to the development and commercialization of these compounds are formidable. They include their generally small market size, Environmental Protection Agency (EPA) registration requirements, unknown health and environmental interactions, and in some cases lack of patent protection. Several different options available to Congress to remove many of these barriers fall into the categories of removing existing disincentives or providing incentives.

One disincentive-reducing means that is currently available would be for Congress to direct EPA to devote more time and manpower to adjusting the requirements for registration for these compounds. These adjustments could be based on findings regarding the amounts that would be used, relative safety of the compounds, and mode of action. An example of this would be the formulation of a narrow policy to cover the registration of pheromones. Such a policy could require that

a material have a very low use rate, that it be a naturally occurring substance, and that it be in the most stringent toxicology category for registration under the narrow requirements. EPA is expressing intentions to move in this direction. The effectiveness of their efforts is being hampered by the internal desire to finish the registration guidelines for conventional pesticides. If Congress were to make the necessary manpower available to EPA specifically tied to directions to accelerate the adjustment of registration requirements to reflect more accurately the dangers from narrow-spectrum pesticides, this situation would be relieved considerably. If EPA had the incentive to tailor registration requirements to the expected level of danger, the number of tests required to register a selective compound would, in many cases, decrease. If industry had fewer data to collect, it would be more willing to develop the narrow-spectrum pesticides.

Two other means would be aimed at items that do not offer proprietary protection, such as U.S. proprietaries on micro-organisms. One would be to offer an extended exclusive license for the development and commercialization of a U.S. proprietary. The present limited period of license for private productions of U.S. proprietaries is generally too brief to warrant facilities, manpower, and monetary commitments from private industry. An extension of this exclusive license period to 10 years after market entry might work as an incentive to introduce materials into the market that are not economically feasible on a shorter time basis. Another would be for Congress to extend patent protection to include micro-organisms. Existing patent laws do not allow for the patenting of micro-organisms. Besides the proprietary protection that could be offered under options in the previous section, Congress could consider passing legislation to allow the patenting of certain micro-organisms. Precedents for such legislation can be found in the Plant Patent Act of 1970. Since the passage of the Plant Variety Protection Act, there has been a marked increase in the level of commercial breeding of new plant cultivars.

Finally, the Federal Government could offer support for the costs of developing narrow-spectrum pesticides. On top of the costs of registration, the potential market size for many selective compounds is too small to provide an adequate return. Interest in these compounds is due mainly to social and environmental, rather than economic, considerations. If their development is to be a high-priority item, Congress should consider subsidizing companies involved in the production of narrow-spectrum pesticides. Some form of subsidization would encourage the commercialization of certain materials that might otherwise not be economically feasible for development.

Several different mechanisms for providing such a subsidy are available. They include:

- **A Government loan program.** This would involve making funds available on a loan basis to carry selective chemicals to the point of market entry after the material has shown initial promise and market potential. Such a loan would be canceled in the event the item was never marketed. Repayment (in whole or in part) would be determined on a sliding scale geared to gross revenues received from the product less pro rata recovery of R&D cost. (This loan system was originally proposed by Carl Djerassi in 1974.)
Such a program would not have to be funded by direct loan. In fact, the program might work best in the environment of percentage Government guaranteed loans from private institutions. Thus the Government cost is reduced over direct loans, the private enterprise money market is stimulated, and the developer, by assuming a percentage of the financial risk, operates at a disincentive to utilize Government funds to solve cash flow problems.
- **Government R&D Contracts.** Where an identified need exists for an item that cannot be economically developed, there

is historical precedent for use of the R&D contract. Governmental costs could be reduced by letting the contract on two different basis: 1) a pure R&D contract that compensates only the R&D efforts of the research and developer or 2) a Government cost subsidy R&D contract that is tied to a lo-year exclusive license to produce the material developed.

- **Tax Credits.** Tax credits could be the lowest cost approach to developing materials which, while socioenvironmentally desirable, might be only marginally feasible from an economic standpoint. Allowance of direct credit against income taxes for a percentage of R&D costs of specified materials (or classes of materials) serves at least two ends. It makes real costs of the Government incentive negligible and keeps competition working in the free enterprise framework by not limiting R&D work to one company.

Unfortunately, tax credits may also be one of the most complex and difficult approaches to administer, with enormous complications regarding whether or not the research should be subsidized by the Government.

- **Competitive Grant.** This approach to funding can be patterned after other endeavors where the Federal grant has been used as a stimulus to R&D efforts.

Development of a Uniform National Cancer Policy

The lack of uniformity in the cancer guidelines is a problem connected to the development, regulation, handling, and use of pesticides. The development of a uniform national policy is an important task that impinges on pest management as well as on many other important activities. Congress should use its oversight and legislative powers to ensure a uniform policy as soon as possible.

DEVELOP EFFICIENT PEST MANAGEMENT DELIVERY SYSTEMS

USDA-sponsored extension pilot programs will be operational in all 50 States in 1979. A framework is being set up in all States on which to build a public system for supporting pest management implementation programs. Congress must decide how rapidly 1PM should be adopted in the United States and to what extent delivery systems should be supported by Federal funds.

Support of Public Delivery Systems

As acceptance of pest management programs increases, an important role of extension will be to provide information and technical support to ongoing private programs. Such support programs will demand stable, long-term support and should include the flexibility to use the funds for facilities for extension pest management programs.

A pest management coordinating team is needed at the Federal level in USDA to provide adequate leadership for an expanded pest management program. USDA should reorder its priorities to create the needed capability to review, coordinate, and administer expanded support programs for pest management implementation.

To expedite implementation, each State should have a State pest management coordinator to head a team of specialists that would include at least one specialist from each of the major pest control disciplines. The team of State specialists will be essential to provide classroom, laboratory, and field training for consultants and scouts to assure successful establishment of pest management in their State.

Foster Private Sector Delivery Systems

If pest management is to be widely adopted, it will be because of the development of a large private sector involvement. Growers should be willing to pay for pest management services, and organizations must exist to offer such services on an eco-

nomical basis. Means of increasing the private sector involvement in pest management can be provided by the Extension Service. Other assistance will come through federally sponsored education and research programs. Additional aid could be provided in some of the following manners:

Support for grower-owned cooperatives could be based on the elimination of some of the financial constraints to their formation. This could involve the subsidization of pest management trainees. It could also involve the banks for cooperatives. A congressional mandate could be given to the Center Bank and the District Bank for Cooperatives to publicize the availability of funds for financing cooperative pest management services. The Farm Credit Administration could also be directed to approve a favorable interest rate for loans made by the district banks for expansion of existing cooperatives or for formation of new pest management cooperatives. For fledgling nonprofit pest management cooperatives, a bill specifically exempting nonprofit pest management associations from taxation would ease the way for their formation.

Setting minimum certification standards for pest management specialists could also help private pest management consulting services. In most States, nothing restricts an individual from calling himself a pest management specialist. Congress could act to see that standards are established that prohibit such individuals from operating in an unrestricted manner. Details of ways to accomplish this are provided in volume II (National Constraints).

Congress could encourage the development of private pest management consultants through some form of support for their potential liability burdens as outlined in chapter V. One approach would be the development of a federally sponsored liability insurance program for consultants. An analogy for such a program exists in a bill in the pharmaceutical area, H.R. 1247. The bill, which was not re-

ported out of committee, would have provided for the establishment of a tax-exempt trust for payment of liability claims. The decision that must be made is whether the gains outweigh the costs to the Government in increased time, costs, and opportunities for fraud. Another option is to offer low-interest

loans for the establishment of private consulting firms through the Small Business Administration or the Farmers Home Administration. Such loans could have the added effect of increasing the opportunity for apprenticeships and applied training for potential pest management personnel.

DEVELOP A NATIONALLY COORDINATED MONITORING PROGRAM

A well designed monitoring system for weather and biological factors can provide the necessary input for the design and use of predictive capabilities in a pest management program. Such a national environmental monitoring system does not exist now. Useful information in research or implementation programs is rarely communicated to others on a timely basis. A national system taking advantage of existing computer and electronic-sensing technology could be designed to meet the needs of pest management.

The National Weather Service's agricultural weather reports are not precise enough and do not have a rapid enough input/output cycle to be truly useful in pest management programs. Agricultural weather is relatively low on the Commerce Department's scale of priorities. Little effort has been made to get more accurate short- and long-range weather predictions on a local level.

Congress could direct the Commerce Department to work with USDA to develop a more precise agricultural weather system. The benefits of such a system would include increased precision in the prediction of pest outbreaks (with resulting savings in control and scouting costs to the grower) as well as a better base from which to plan general farm and rural operations. The cost of such a program could be kept at a reasonable level by making use of existing facilities and technology.

Several land-grant universities are now developing their own computer facilities for biological monitoring and prediction capabilities. These local efforts could be turned into a

national biological monitoring system, where appropriate, by linking them to a national computer. This would be similar to current activities of the National Weather Service. It would create a network for the national accumulation of data from each of these State facilities. Congress could accomplish this by specifying appropriations for the establishment of a national facility for the collection and coordination of State information. The data accumulated could be used to trace migratory insect movements as well as to describe the status of other pests. Such information would also help to limit scouting and control costs to a specific period of time around the expected danger period. By using this information, significant savings can accrue to the farmer through decreased pesticide use and decreased scouting costs.

An expanded national effort is needed for the early detection of introduced pest species. Examples of new pests that have entered the country undetected and remained so for several years include the cereal leaf beetle, the citrus blackfly, and witchweed. Many of the major pests of our crops are introduced pests. If the eradication of introduced pests is to occur, early detection is absolutely essential. A review of the present Noxious Weed Act and adequate funding to allow inspection of shipments to the United States for exotic weed species should also be accomplished.

Pesticide use surveys could also be coordinated by USDA. Each State now has a cooperative crop-reporting service that can efficiently and effectively conduct such surveys.

USDA could provide national leadership and coordination so that State survey information can be readily assembled on a regional or national basis. Questions have been raised regarding the need and utility of an extensive use survey system. USDA already collects pesticide data. These data are extremely important in giving an overall picture of trends in pesticide use.

One means that would be extremely useful not only for training programs but also for implementation efforts and pest monitoring would be for Congress to support existing plant health clinics as well as help form new ones in the States. Animal health clinics are widely developed. There is a need to develop such services and teaching centers for plants. The clinics could serve as the focal point for pest management implementation efforts. They would include diagnostic as well as information capabilities; the accurate diagnosis of plant pest problems would eliminate much of the misuse and waste of pesti-

cides and other control agents. The clinics could also provide staffing and facilities for clinical programs in pest management. With adequate support, they could be the backbone of the practical component of pest management degree programs. The volume and range of pest problems brought to the clinics would automatically monitor pest activities for each State. The clinics would also greatly increase the likelihood of detecting introduced pests in time to institute eradication or other indicated activities. Unfortunately, very few adequately sized and staffed clinics now exist.

Cost-effective support for the formation or improvement of plant clinics could be given by offering matching funds to those States willing to join in their development. Funds should include provisions for facilities as well as for staffing the clinics. Additionally, funds should be provided for interdisciplinary faculty participation in the clinics, for both diagnosis and training.

PROVIDE TRAINED MANPOWER AND TRAIN-TO-ENTER PROGRAMS

Lack of trained manpower at several educational levels is an obstacle to the development and implementation or improvement of pest management systems. Increased funding earmarked for educational programs in pest management at all levels is needed to provide an impetus for more rapid increases in utilization of the pest management approach.

Support for Pest Management Training Programs

Only university administrators can act on many of the items outlined in this section. The prime vehicle for congressional action in pest management education would be to provide funds to support university programs. They are needed for the following levels:

- self and mutual retraining and reorientation of administrators, professional researchers, teachers, extension personnel, and leaders of State and Federal agencies;

- nondegree or certificate training programs or special short-course sessions for paraprofessionals (scout supervisors and scouts);
- integrated, high-quality baccalaureate degree programs to prepare students for graduate study in traditional disciplines as well as technical positions in industry, agribusiness, and farm, home, forest, and urban pest management;
- establish or improve pest management programs at the master of science level consisting of nonthesis terminal degrees for students preparing to be practicing professionals and a thesis degree for those aspiring to the Ph. D. level with a pest management emphasis or a professional doctorate in pest management; and
- a Ph. D. in traditional crop production or protection discipline with a minor in pest

management or minors in two related areas for preparing teachers and researchers for pest management.

A further possibility recommended only for consideration at select institutions, perhaps as a consortia basis, is a professional degree in pest management for training practitioners with the diagnostic and clinical skills to operate the pest management programs required to preserve the future health of our crops.

Support is also necessary to initiate and support medium-term postdoctoral fellowships for research for highly qualified new Ph.D.'s who would need additional experience. Such a program would provide incentives for outstanding young scientists to enter the field and, at the same time, make opportunities for creative developments in the field of pest management.

Adequate clinical components are a critical need in any of these pest management training programs. Universities should be encouraged to require a pest management internship. This would require the development of a strong certification program and a commitment on the part of certified practitioners as well as university administrators and faculty.

Congress could help by providing support to the universities for administering the internship program, to the certified practitioners, and to the students during field internship. Advantage should be taken of the opportunities offered by the USDA-sponsored pest management pilot programs. Pilot project funds could be used to provide training and subsistence for the pest management degree candidate. It could be required that every Extension Service action program include an internship component. The net result of this approach is a self-renewing supply of qualified scout supervisors and experienced pest managers available to public and private pest management organizations and the pesticide industry.

The Federal Government could also provide funds to support degree candidates for internships with private consultants, grower

co-ops, and other organizations. These funds could serve as an indirect subsidy to fledgling organizations as well as provide opportunities for field experience.

Competitive Study Leave Grants

The need for updating professional skills for working scientists in rapidly proliferating fields such as pest management can be met by a system of study leave grants. These would provide an additional way to take advantage of the areas of technical expertise already forming at certain land-grant universities. Such a system would allow a specialist in pest management at one university or Federal unit to spend 6 months to 1 year at another university with a different set of problems and expertise in pest management.

Reducing Manpower Requirements

Another approach to the problem of lack of appropriately trained manpower is to reduce the labor required for pest management programs. The major portion of man-hours invested is in scouting and monitoring pest populations, crop development, and ecological factors that influence pest problems. Two approaches to reduce labor intensity have been identified:

- Areawide pest monitoring and population prediction on the basis of computer models will allow scouts to cut their time in the fields to the critical days of pest activity. Scouts could then cover a larger area.
- Develop and use automatic mechanical devices for monitoring pests and ecological factors influencing them. Most of the technology exists to design remote sensors tuned to different pheromones and sound frequencies to monitor for insect pests and provide rough estimates of population levels. Monitoring devices for vertebrate pests are also possible. Some devices are available for monitoring temperature, humidity, rainfall, and length of leaf wetness periods. These can be connected to minicomputers that

can signal dangers of plant disease infections. The development and techniques for use of such monitoring equipment involve research by both the private and public sector. Many segments of private industry, from the manufacturers who build them to the growers who save on their own time and scouting costs by using them, are interested in such monitoring systems. Congressional interest in pursuing this approach will depend on the level of private sector support and the desire to use pest management as a means to provide jobs to rural Americans.

Establish Regional Pest Management Study Centers

The establishment of regional pest management study centers is discussed in detail in the section "Improve Cooperation and Coordination." Regional centers could help train and update crop protection personnel in the latest developments in the field. Regional centers would be appropriate for workshops and training for professional pest management personnel but not for scouts or scout supervisors.

OVERCOME GROWER SKEPTICISM

Growers are the key to the adoption of pest management programs. Three approaches to obtain increased grower involvement have been identified: through education, by providing incentives, and by regulation.

Education

Education has been the traditional method of bringing new developments and technology to growers. This approach to grower involvement in pest management has the advantage of grower acceptance and an existing cooperative extension system to teach growers. The only missing element for many situations is the availability of feasible, economically sound validated pest management programs. Congress will play a critical role in determining the rate at which such programs are developed.

Providing Incentives

Providing incentives to increase grower participation in pest management is another

option. Low-cost Federal crop insurance is one way to cover losses to pests and help overcome skepticism. There are major problems involved in establishing and operating such a program. Also, well-conceived and validated pest management programs should not be riskier than other control approaches.

Regulating Grower Involvement

Regulating grower involvement is a sensitive area because of current attitudes toward Federal regulatory efforts. Restrictions imposed on a national level would be met with strong opposition by growers. There is some interest in the use of locally enacted pest management districts to regulate grower participation. These districts can be established by a State enabling law and then confirmed by local grower referenda. In Texas, enabling legislation has been passed but no districts have yet been established.

IMPROVE COOPERATION **AND COORDINATION**

Problems in cooperation and coordination as a constraint to pest management exist

within the Federal Government, between the Federal Government and the States, and with

the State and land-grant university complexes. The problems and options to reduce the problems are outlined below.

Mechanisms to Coordinate Efforts of Federal Agencies

Legislation exists that is designed to correct any problems among Federal departments and agencies in the amendment to section 401(h) of the National Science and Technology Policy, Organization, and Priority Act of 1976 (90 Stat. 471, 42 U.S.C. 6651(h) provided by section 1406 of Public Law 95-113, 91 Stat. 986). Nevertheless, we address here specifically the problem as related to pest management. The problem of unclear and sometimes conflicting goals being pursued by different agencies has severely hampered the Federal effort in pest management. Lack of a mandated responsibility for pest management support activities or a plan on which to organize agency programs is at the heart of this problem.

Two basic premises should be included in any deliberations on a Federal pest management strategy: 1) that USDA, with its extensive research and extension network, should have the primary responsibility for pest management programs, and 2) that EPA, with its responsibility for protecting the environment, has a valuable role in supporting the development of innovative tactics for and approaches to pest management. Other agencies, such as the National Science Foundation (NSF) and the Food and Drug Administration (FDA), also interact with 1PM development and implementation. These roles and interactions are taken into account in the following discussion.

Four different mechanisms to ensure better cooperation and coordination in the Federal pest management program are outlined. While they are presented separately, they would have the strongest effect if combined.

- A representative group from outside the Federal Government could be established as an oversight group for pest management. Such a group would be

composed of individuals involved in pest management from the Federal, State, and private sectors. They would know the grassroots needs for pest management and could bring that perspective to bear while reviewing the Federal efforts. With no control over budgets and staffing, only strong executive support could make such a group an effective agent for coordinating Federal efforts. It could be most useful in an advisory capacity.

- To ensure that groups with program responsibility become involved, an inter-agency review group on pest management could be formed. To be an effective policymaking body, it would have to consist of individuals at the assistant secretary level from agencies with programs related to pest management. It would examine the current structure of Federal initiatives in pest management and suggest means to streamline them. It would also serve as a forum for the development of a national pest management plan, including program goals and agency responsibilities. The drawback here is that such groups are often ineffective. Starting with the intentions of making policy, they frequently evolve into forums for technical exchange, rather than for policy discussions.
- Congress could intervene and clarify the roles and responsibilities of the agencies involved in pest management. The aim would be to start with the functions of USDA and EPA outlined at the beginning of the discussion, include FDA, the Council on Environmental Quality (CEQ), and the Department of Defense (DOD), and other appropriate agencies, and assign specific program responsibilities and areas of interagency cooperation within pest management. The effect would not be to consolidate responsibility in **one** agency but to provide support and direction for intra-agency and interagency efforts. Existing areas of interagency cooperation could be given formal recognition, and other areas for future cooperation.

tion could be outlined. If combined with the formation of an interagency review group charged with overseeing the success of the cooperation, the effect of any congressional effort could be greatly enhanced. The major drawback to this approach would be the interest required in Congress to undertake such a task.

- A Federal unit without present or future funding interests could be given a coordinating role for the national effort in 1PM. CEQ has already been acting to some extent in this role. To be effective, its coordinating and oversight role must be clearly delineated and adequate staffing provided. The staff should be supplemented by an outside advisory group as outlined previously. The advantages of this option would be to place a noncompetitive Federal unit with ready access to the executive branch and all Federal agencies involved in 1PM in a position to monitor and develop policy for the Federal effort. This option cannot function effectively without a clear mandate, a modest staff knowledgeable in the subject matter, and an appropriate advisory group.

Cooperation and Coordination Between Federal and State Agencies

Of primary concern is the relationship between USDA and the land-grant universities with teaching, research, and extension responsibilities. The main problems are in the areas of program development, priorities establishment, and budget development. Development of the planning and coordination mechanisms called for in title XIV of Public Law 95-133 and the subsequent reorganization within USDA to form the Science and Education Administration and the organization of Interregional Project 6 should make coordination and cooperation easier. However, it must be encouraged at every level. Congress can contribute by ensuring that the intent of Public Law 95-113 is fully implemented and funded.

Several potential problems face the regional and national planning approach that is being put in place. One is the potential difficulty of fitting AR programs of national focus into the regional priorities. A second problem is adopting the State organization of the extension services to a regional structure. Related to this is the fact that States will be wary of another layer of administrators apparently prepared to dictate regional priorities in extension to them. A final problem is that by assigning priorities on both a national and regional basis even less funds will be going to work on critical local needs.

Coordination and Cooperation Within the Land-Grant Universities

Traditionally, pest management teaching, research, and extension have been approached from separate disciplines. 1PM requires consideration of more than one discipline and their interactions. This necessitates, as previously mentioned, not only even stronger discipline teaching and research but interdisciplinary and multidisciplinary teaching, research, and extension considerations. Present funding is simply not adequate to even approach this job.

Providing additional funding at the Federal level is essential for the development of new initiatives in 1PM in teaching and research just as it has been in the extension pilot programs. Congress can contribute the most to improved cooperation and coordination among the disciplines, especially in research, by providing significant additional funding. This additional funding will be more productive and effective if provided to States through the regular funding under the Hatch and Regional Research Acts by USDA's SEA/CR. This provides stable funding that enables the development of scientists in a tenure track of teaching and research. It also allows priorities to be set at the local level to develop programs that address the major 1PM problems in the local producer areas,

Establish Regional Pest Management Study Centers

A major limiting factor in the advancement of pest management is a space/time problem. The study, comprehension, and application of the pest management concept has been done largely on a personal or institutional basis. Until recently, few institutions had even a formal course or seminar in pest management. The few pest management specialists that exist are scattered over the country and the world, with inadequate opportunity in time, facility, or support for mutual discussion of ideas and strategies.

One option suggested to reduce this limiting factor is to establish regional pest management study centers. Such centers would have facilities for students, professors, researchers, extension specialists, and others to work, study, and train in pest management. They would combine a "think-tank" atmosphere with research, education, and implementation programs and would provide a place for the different groups in crop protection to discuss and attempt to unify approaches to pest management.

This approach would use the centers of technical strength in pest management that are developing across the country. At several land-grant universities advanced work is already being done in pest management. The base existing in these universities could be used to form a network of regional centers for pest management, education, research, and implementation. These centers could combine the think-tank atmosphere with work directed toward the needs of pest management programs in their regions.

Careful consideration should go into the design of each of the regional centers in

terms of location, facilities, administration, funding, missions, and philosophy. The centers should be located at land-grant universities that have evolved as leaders in pest management and where facilities already exist or can be constructed. Congress could authorize and fund establishment of the centers. Funds could be allocated to the respective institutions to include hiring directors and permanent support personnel.

While the option of creating regional study centers promises to improve cooperation and coordination as well as to assist in training personnel, there are potential problems that must be considered. The problems and lack of success experienced with regional centers in other fields suggest that the concept may not be as useful in practice as in theory. The precise role of the centers in accomplishing their goals must be carefully evaluated to determine the probability of success. Administrative costs could become excessive and detract from the programs. In addition, linking the centers to institutions identified as leaders could increase the gap and the jealousies between the have and the have-nots in pest management. Such an occurrence could make regional cooperation extremely difficult.

Competitive Study Leave Grants

This option was presented under the training section. In addition to its merits for training, this option would help improve cooperation and coordination among Federal agencies, between the Federal agencies and the States, and among the States. The interchange of personnel on study leaves would improve communication, understanding, and the flow of information. Properly administered, this option could be a very positive force in furthering pest management.

REVIEW IMPACTS OF COSMETIC (ESTHETIC) STANDARDS

If Congress decides that reducing the use of chemical pesticides whenever possible is one of the goals of Federal pest management efforts, existing food quality standards

should be evaluated. As noted in chapter V, the high-quality standards for certain fruits and vegetable crops necessitate the extensive use of chemical pesticides. The safety or nu-

tritional value of the produce may or may not be improved by these quality standards and must be judged on a case-by-case evaluation.

Congressional efforts in this area could have two approaches. One would be aimed at the standards it has under direct control, such as the defect action levels (DALs) administered by FDA. An assessment of the effect of DALs on pesticide use, pesticide residues, human health, and market value similar to an environmental impact statement should be conducted. Such an analysis would com-

pare the benefits from present DALs and those that would accrue from less-strict levels. It would allow a responsible decision to be made on the proper levels of defects allowed while protecting human health.

The second part of the congressional effort would be aimed at the broader issue of consumer and processor acceptance of damaged produce. Studies should be conducted on market elasticity and consumer willingness to accept blemished but safe food in order to reduce pesticide use,

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