INTRODUCTION

Of all the crops grown in New York, apple ranks number one when it comes to the pest complex affecting the crop. It is plagued by a large number of pests including insects, mites, disease organisms, rodents, nematodes, birds, deer, and weeds. Numerous crop protection measures must be utilized in order to produce commercially acceptable fruit and maintain healthy productive trees.

Presently, and for the foreseeable future, the use of effective pesticides is essential to continued apple production. However, total reliance upon chemical pesticides for control of pests is not the final answer either. Several problems have arisen when a strict chemical approach to apple crop protection has been followed. Insect, mite, and disease organisms have developed resistance to certain pesticides. Pesticide costs have increased sharply in the past 5 years causing them to become one of the most expensive elements in fruit production. Public concern for healthful foods with minimum pesticide residues and a cleaner environment has led to laws which have reduced the availability and permitted uses of pesticides. Quite obviously, all of our resources must be carefully managed. This is the role of integrated pest management (IPM).

These developments have also caused researchers and extension specialists to re-examine their roles in orchard crop protection. Historically, entomologists or plant pathologists worked directly in their disciplines on certain methods for controlling insects or disease organisms. The integration of control methods into the total production system was left for the most part to the producer who had to do this on a trial and error basis. Pest management has now caused crop protection scientists to turn to other disciplines for input and interaction. No longer do they work on isolated events or problems. The extension specialists who formerly viewed problems on a general or average level and who had limited means for fast dissemination of pest information now find that they can relay more specific information in a matter of seconds to all elements. Growers and fieldmen now have the tools and techniques available to help carry out pest management.

Successful integrated pest management in New York has all come about as the result of the efforts of many growers, agents, researchers, extension specialists, and fieldmen working together in a demonstration Apple Pest Management Program. While individual, yearly reports...
have been prepared, this is the first comprehensive report on the progress of this program.

OBJECTIVES

In 1973, the Apple Pest Management Program was Established with the following objectives:

1. To reduce through efficient pest management, the amount of pesticide used for insect, mite, and disease control on apples without reducing the quantity and quality of fruit.
2. To integrate all the useful known and new pest management techniques for fruit pests into a workable system and demonstrate the system in a large pilot project.
3. To train a core of specialists in fruit pest management who would be able to continue and expand the practices demonstrated in this project through grower pest management cooperatives, commercial enterprises, or other feasible systems.

As these objectives began to be realized, it became imperative that what had been learned in the pilot project should be brought to the attention of all fruit growers in New York.

PROJECT ORGANIZATION AND SUPERVISION

Steering and Advisory Committees

The overall direction of the Apple IPM Program was provided by a Steering Committee composed of individuals from the disciplines of Entomology, Plant Pathology, and Pomology as well as county and regional fruit agents and IPM farm advisors. A number of subcommittees bore responsibilities for the various programs and components. The Steering Committee met frequently to plan the program and to discuss results.

The opportunity for growers, fieldmen, and other concerned individuals to offer direction and advice to the Steering Committee was provided by Advisory Committees. These committees were composed of both participating and non-participating growers and chemical and processing fieldmen. There were three Advisory Committees which functioned in various regions of the State. Meetings were held at least twice during each year.

Disciplinary Inputs

The organization and implementation of an IPM program was accomplished through the cooperative efforts of individuals in many disciplines. The approach used in New York was to consider all pest problems, or potential pest problems, from a holistic point of view rather than to concentrate on a key pest or strategy. Research and extension personnel from the disciplines of Plant Pathology, Entomology, and Pomology collaborated in the program from the very first day. Also, scientists from the disciplines of Natural Resources, Atmospheric Sciences, Agricultural Economics, and Computer Sciences added their talents to the overall effort. The success of the Apple Program in linking the disciplines together is now serving as a model for other commodity IPM programs getting underway in New York.

Grower Cooperation

In the initial 3 years, the assistance and understanding of growers in one area of Wayne County were solicited in organizing the IPM Demonstration program. Although some of these growers followed little or none of the advice rendered during these years, all of them cooperated with the program. In 1976, growers in Wayne County were given the opportunity to enroll in the program on a per acre fee basis. They responded to the extent that their annual contribution of nearly $30,000 is used to support the entire demonstration program. Many growers who have not directly participated in the IPM Program have cooperated extensively by providing timely, accurate spray records and allowing IPM personnel to check their fruit at harvest. The concepts and ideas generated by the research and extension specialists could not have been adequately tested without the cooperation of the fruit growers of New York.

Farm Advisor Program

The complexity of pests on tree fruit in New York and other northeastern fruit states warranted a careful approach to implementation of IPM concepts to crop protection. In 1973, the Apple Pest Management Project began by training and teaching individuals all phases of crop protection. This was deemed essential if IPM were to be truly implemented and understood. At the same time, new techniques and practices were examined and explored. The underlying premise was that if IPM was going to be used in New York orchards, a core of specialists would be needed. Through the extension IPM pilot program, individuals were to be trained to pursue careers as private consultants, fieldmen, or extension fruit agents.

In the early years of implementation, much time was spent training and organizing personnel, developing sampling methods, and cataloging grower practices. During this time, the pilot program cooperated with approximately 16 growers on 20 farms having 1,126 acres of apple, all located within a 5 square mile area of Wayne County. In 1975, these participating growers were encouraged to follow IPM advice and recommendations and were asked to financially support the program through voluntary contributions of $2/acre. There was a wide range in the level of response to the advice given, but all growers cooperated in furnishing records of their practices. Thus, growers could be grouped according to how they followed IPM advice.

In 1976, a number of changes took place in the program operation. The IPM approach was broadened to include all tree fruit. The main reason for this change was that growers wanted advice on all their fruit crops, not just apples. Furthermore, new techniques and practices for conducting IPM on pear and stone fruits were being developed. The
program was opened to all growers in Wayne County under an enrollment fee of $5/acre for stone fruit and $10/acre for pome fruit. Growers wishing to participate had to place at least one farm unit in the program.

This approach was carried out by two farm advisors who had been with the IPM program as trainees. The farm advisors worked with individual growers to develop IPM practices tailored to their needs as determined by careful monitoring and inspection. They assisted growers throughout the year in planning control programs, surveying orchards for pests and beneficial organisms, maintaining weather, disease, and insect monitoring devices, calibrating spray equipment, and making day-to-day decisions and recommendations.

In 1976, virtually all of the recommendations were made and followed on 2,523 acres of apple having a market value of approximately 3 million dollars. In 1977, all but two growers returned to the program (95% return) and the acreage increased slightly to 2,600 acres. Also, in 1977, a new dimension was added to the project in that two trainees were brought in to learn and experience all phases of the IPM approach. These individuals spent 8 months with the program learning from the farm advisors. Upon completing this "internship" they moved to pest manager-type positions in the private sector. With this addition, the farm advisor program assumed the multiple roles of demonstrating, teaching, and developing IPM practices and techniques.

**Pest Management Assistants**

The success of the farm advisor approach created the need to carry forth the concepts learned in this project to all fruit growers in New York. Furthermore, models and sampling techniques needed to be validated in each fruit growing region. In order to assist the extension fruit agents in this task, pest management assistants were assigned to them during the growing season. In 1975, this approach was implemented in the Western New York area (Monroe, Niagara, Orleans Counties) and expanded to the Hudson Valley region in 1976. The assistants monitored selected orchards for pest activity, spray applications, and weather information. These data, which were furnished daily to each agent for use in radio broadcasts, newsletters, and Code-A-Phone messages, enabled them to provide current, reliable, and meaningful information to growers. As part of this approach, agents interpreted the survey information for a few individual farms to further validate the IPM practices.

**Tools and Techniques**

The best way to illustrate how IPM is being implemented at the farm level is to examine the tools and techniques used in the program.

**Orchard Maps**

An essential element in communicating with growers is an understanding of where action is required. In the initial phase of the IPM program, it was evident that some growers could greatly benefit from having their blocks of fruit trees numbered and the acreage accurately determined. Not only was a grower then able to plan his control strategies more effectively, but was even able to better estimate the size of his crop. The use of orchard maps, together with information on tree size, spacing, variety, and age, was a key element in carrying out IPM.

**Sprayer Calibration**

Calibration of spray equipment belonging to growers in the Farm Advisor Program was a standard practice. Application equipment was properly adjusted and nozzled to deliver the correct amounts of material. In some instances, it was easier to adjust the amounts of materials going into the tank than to strive to maintain proper machine calibration throughout the season.

**Strategy Sessions**

One of the most useful techniques in the Farm Advisor Program was a pre-season planning session with each grower. At this time, the grower was alerted to potential pest problems based upon observations made during the previous year. Discussions also centered on the intended market for each block of fruit (fruit can be marketed fresh or process) and the preference the grower had for certain spray materials. A "game plan" was then worked out along with preliminary estimates of pesticide requirements for the year. The methods for communication between the grower and farm advisor were also established at this time.

**Weather Monitoring**

The importance of weather and its related effects on pests and crop development cannot be overstated. The IPM program established and maintained weather stations in various locations throughout the fruit regions. Rainfall, leaf wetness, and hourly temperature and humidity were recorded at these sites. Most stations were visited every day, including weekends, during the growing season.
Disease Monitoring

Monitoring for most tree fruit disease is difficult because once the symptoms are present, the infection has already taken place. The problem then becomes one of attempting to prevent additional infections. In order to anticipate the potential threat from diseases, such as apple scab, a number of laboratory assays were used. For example, overwintering spores were checked for maturity and for their potential to be released under certain climatic conditions. Spore traps were used to follow the release of spores during a rain.

In some instances, it was possible to determine the extent of fungicide residues by placing newly growing leaf and fruit parts in petri dishes containing a fungus. Within 24 hours, a determination of residues could be made in time to make spray decisions.

In monitoring for fireblight, flower parts and overwintering cankers were checked on a regular basis to determine bacterial populations.

Terminal shoots known to contain powdery mildew were tested each spring to determine the effects of low temperature on survival of the fungus. In addition, the weekly orchard inspections provided a chronological picture of mildew development.

Pheromone and Bait Traps

Sex pheromone traps were used to monitor flight periods of most of the lepidoptera that threaten tree fruit. In the initial years of the program, traps were placed on a 10 acre grid system across the 5 square mile IPM project. In 1976, traps were located on a more practical basis with placement guidelines being 1 per farm up to 50 acres and 1 for each additional 50 acres. Occasionally, a trap was placed on the perimeter of an orchard to detect immigration from nearby abandoned orchards. As a rule, only the codling moth and obliquebanded leafroller traps were used on most farms. Traps for other species (i.e., redbanded leafroller, oriental fruit moth, lesser appleworm) were used only if that pest had been a problem in the previous year. Traps were also placed in several abandoned orchards and read daily to determine seasonal activity of each species.

Interpretations of trap catches were made in several ways. For codling moth, catches in commercial blocks that approached those in abandoned blocks were considered serious. The surroundings of the farm and the past pest history were then considered before a control decision was made. For leafrollers, problems usually had been noticed by visual inspection, and the traps served as a timing device for sprays against adults and newly hatching larvae. If a control measure was used, the trap often gave a reading of the effect on adults. Newly developing problems were often evident in orchards where trap catches equaled or exceeded those in abandoned orchards.

Bait boards were successfully used for monitoring the apple maggot and the cherry and black cherry fruit flies. These pests are not found in most commercial orchards, but readily migrate into commercial blocks from nearby abandoned orchards and wild fruit trees. This migration was detected by strategically placing these bait boards around the perimeters of orchards. Meaningful interpretations of trap catches could only be made when the boards were checked every 3 days. The key to successful use of all traps and bait boards came from knowing the pest history on the farm and the environment surrounding the orchards.

Orchard Inspections

A routine for inspection of orchards was established and guidelines were drawn up. This became one of the essential techniques in IPM when it was carried out on a weekly basis. Ratings for determining the seriousness of various pests were established for most insects and diseases.
Predatory Mites
Cooperative efforts between research and extension resulted in the identification of *Typhlodromus pyri* as the chief predatory mite in western New York, while *Amblyseius fallacis* was identified as the predominant species in the Hudson Valley and the Champlain Valley regions. The effects of most of the pesticides used on fruit trees were evaluated for both species of predatory mites, and tables of relative toxicities were drawn up. While the Michigan mite model for *A. fallacis* worked well in the Hudson Valley, the model did not apply to *T. pyri*. This predatory mite was not as voracious a feeder, but was resistant to many of the commonly used insecticides, including Car-baryl (Sevin). While mite brushing and counting were used in the early years, a more practical approach using a hand lens to evaluate orchards was used from 1976 on.

Beneficial Insects
Every effort to conserve beneficial insects was made by carefully selecting and timing pesticide applications. For example, the parasite of woolly apple aphid was encouraged by avoiding the use of certain pesticides known to be harmful to the parasite. Apple and rosy aphid predators were also followed and care was taken to preserve them.

Data Management
Extensive use has been made of computer programs for organizing and analyzing data gathered in the IPM Project. Programs were designed to organize insect trap information, grower spray records, fruit harvest records, orchard inspection records, and weather data. Extensive files for some 900 orchard blocks over a 5-year period have been created to assist in long-range analysis.

Pesticides
One of the most important tools in orchard IPM is pesticides. Great pains were taken to understand and use these materials effectively and only as needed. They were continuously evaluated at the grower level for effectiveness, proper timing, and cost.

Application Methods
During the course of each season, pest problems generally occurred only in sections of a grower's farm so that only the problem portions required treatment. Various methods of pesticide application were encouraged. These included alternate row middle spraying, perimeter spraying, and individual block applications. None of these was used on a regular basis, but rather were used according to the appropriateness for a particular problem or situation.

Abandoned Tree Removal
Many of the pests which threaten tree fruit in New York exist outside the orchard in wild and abandoned trees. In 1974, a program of removing all trees of this type was undertaken in a 1.5 square mile area. As a result, nearly 3,000 trees of various sizes were treated with an herbicide in an attempt to remove them as viable hosts for pests. Despite, several treatments, a number of the older trees continued to survive and bear fruit. There were no obvious benefits in terms of decreased pest pressures during the following growing season. The problem was compounded by a proliferation of wild trees on property of numerous private landowners who were not willing to have the trees removed.

Fruit Harvest Records
Sound evaluations of IPM can only be made on the basis of the quality and quantity of the crop at harvest. A system was established for evaluating various blocks of fruit at harvest time for pest damage. This not only pointed to program weaknesses, but aided in planning the next season's strategies. With this type of project there is no way to scientifically measure changes in orchard productivity. There was no obvious increase or decrease, nor was there any reason to assume a change on the basis of practices used.

Communication
In the early years of IPM, data and information were rendered to each grower through oral reports when the farm was visited and through post cards when an immediate evaluation could not be made. IPM information was also made available to county agents and regional specialists for use in newsletters and radio shows.

In the early years, this was accomplished through periodic telephone calls and letters to agents from the IPM Field Manager. Beginning in 1978, all of the fruit agents were able to access current information on a daily basis through a computer-based information delivery system called SCAMP. The SCAMP system is located in a computer at the New York State Agricultural Experiment Station in Geneva and can be accessed from county offices through computer terminals. The SCAMP system provides field reports from all fruit regions, summarizes events, and provides interpretations of important information by extension specialists. It also provides daily weather forecasts. It serves as a forerunner to an expanded computerized approach currently underway.

By 1976, most fruit counties had installed a Code-A-Phone message system. This permitted growers and fieldmen the opportunity to obtain a 3 minute message on the latest crop and pest developments.

The concepts and principles of IPM are also delivered to all those connected with tree fruit production through grower meetings, fruit schools, winter workshops, and field days. Newspaper articles are also an integral part of alerting the agribusiness community and the public as to the nature and results of IPM.

Strategies
One of the most difficult concepts to instill in growers is
the need to have a strategy or game plan from which to work. This strategy must also be designed to be flexible and dynamic. For most insects and diseases, the control strategy may be very similar from year to year, but the timing of individual control measures could be very different. Very simple observations, such as the stage of development of a mite, often cause a change in control strategies resulting in savings of $20/acre or more. Growers who are flexible and open to changes in strategies reap the benefits.

RESULTS

Grower Pesticide Use

In each of the years, extensive and accurate spray records were obtained from growers participating in the Farm Advisor program. Growers who participated in the Pest Management Assistant program also submitted spray information. In addition, a number of growers who did not participate in any formal IPM program also submitted records. All records were collected soon after sprays had been applied in order to insure accuracy. Each grower submitting records received a harvest evaluation of his fruit. Extensive use of aerial photographs insured that the correct acreage for each orchard block was available. All spray record information was stored on computer and was easily retrievable. In addition to spray dates and materials, the program also kept track of rates per acre of each material, gallons per acre of finished spray product, concentration of spray, price of materials used (Fig. 1), and dosage equivalent. The Dosage equivalent (Dose Equiv.) is calculated by dividing the actual rate of pesticide applied by the Cornell recommended rate. The Cornell recommended rates for fruit tree pesticides are published each year in the Cornell "Redbook."

Despite extreme differences in the type of season (1973-1978), i.e., wet, moderate, or dry, and varying amounts of pressure from certain pests, fruit quality as a result of pest damage was only rarely affected.

Growers in Farm Advisor Program

For the most part, growers participating in the Farm Advisor program did not experience any significant increase in pest problems. Except for isolated instances, their fruit quality and quantity were comparable to growers outside the program.

However, pesticide use patterns for growers participating in the Farm Advisor program in each of the 6 years showed a marked decline in the use of insecticides.
and fungicides and a slight decrease in miticide use over the entire period (Fig. 2). This decline amounted to an average decrease of 50 per cent in insecticide use and a 27 per cent decrease in fungicide use. This trend toward decreasing use of pesticides is encouraging. However, the emphasis of IPM is correct timing and placement of pesticides. Succeeding growing seasons may well require the use of more pesticides.

Examination of pesticide cost records from IPM farms also shows that growers' pesticide costs decreased in 4 of the 5 years of IPM using the first year as a base (Table 1). This happened despite the dramatic increase (40% between 1973 and 1975) in the price of the most commonly used materials.

All of this was accomplished with little or no effect on fruit quality and quantity. In addition, no new pest problems have begun to develop on these farms.

Table 1.—Growers participating in IPM Farm Advisor Program.

<table>
<thead>
<tr>
<th>Year</th>
<th>Pesticide* Cost/Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>$87.06</td>
</tr>
<tr>
<td>1974</td>
<td>80.45</td>
</tr>
<tr>
<td>1975</td>
<td>88.84</td>
</tr>
<tr>
<td>1976</td>
<td>78.77</td>
</tr>
<tr>
<td>1977</td>
<td>71.94</td>
</tr>
<tr>
<td>1978</td>
<td>70.51</td>
</tr>
</tbody>
</table>

*Insecticide, miticide, fungicide

Figure 2.—Average dosage equivalents for 5 apple farms (256 acres) in Wayne County, New York, that have been in IPM since 1973.

Growers in the Pest Management Assistant Program

Growers participating in the Pest Management Assistant (PMA) program were selected based on geographic location and willingness to cooperate. Each of these growers received information from the PMA, but only some of them requested interpretation and recommendations from their respective agents. During the 1975 season, this request for interpretation and recommendations was carefully documented by the extension agent in the western New York regions. From his observations, growers were categorized as: following IPM closely, following advice in part, and not following advice. The results for 1976 are recorded in Table 2.

In essence, it shows that growers requesting advice and interpretation spent fewer dollars and used fewer pesticides than those in other categories.

During the 1976, 1977, and 1978 seasons, PMA's were assigned to three areas of the State. In addition to collecting pest information and events over a large geographic area, they were able to assist extension agents in educating and training growers in the tools and techniques of IPM.

There are several problems associated with the PMA approach. Because of the seasonal nature of the work, new people must be trained each year. In a short period of time, they must familiarize themselves with pests, growers' orchards, monitoring methods, etc. They must also gain agent and grower confidence in the reliability of their scouting reports. Since students usually are employed as PMA's, these difficulties are not often overcome until mid-season. In addition to these problems, the PMA's usually require a weekly mini-training session. For these and other reasons, the PMA approach was discontinued at the end of the 1978 season.

Growers Joining and Leaving the Farm Advisor Program

In 1976, growers assumed full financial responsibility for the Farm Advisor program, and many new growers entered into the program. Some of these growers had already been supplying pesticide use data to us so a comparison could be made of their spray records before and after entering IPM.

At the same time, two growers left the Farm Advisor program but continued to supply the program with pesticide records. Again, a comparison of "before and after" type could be made.
The results (Table 3) show that growers who joined IPM in 1976 used less pesticide and thus spent fewer spray dollars than in the previous years. Growers who left IPM saw almost a two-fold increase in insecticide use (Table 4) after leaving the program. Fruit quality was essentially unchanged for all growers, in all categories.

Comparison of IPM and Non-IPM Growers

In order to maintain current accurate spray records of non-IPM growers, we were often forced to rely on growers who kept good records. Many of these growers were also very adept at decision making insofar as pest management was concerned. Furthermore, with each succeeding year, more information on pest activity, monitoring methods, and control strategies were presented to all growers in Wayne County as a result of the Farm Advisor program. This very definitely influenced many spray decisions. In essence, the gap between IPM growers and non-IPM growers grew smaller with each succeeding year. However, in the final analysis, comparisons of pesticide use between non-IPM growers and IPM growers (Fig. 3) showed that non-IPM growers used more pesticides each season. Records from growers in other fruit growing regions of the State (also non-IPM) showed a higher pesticide use when compared to IPM growers.

Table 2.--Tree fruit pest management county agent + pest management assistant (1976).

<table>
<thead>
<tr>
<th>Growers</th>
<th>Avg. dosage equiv./farm</th>
<th>% clean fruit</th>
<th>Pesticide* costs/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I M F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>9.4 1.4 18.4</td>
<td>98</td>
<td>$121.47</td>
</tr>
<tr>
<td>B</td>
<td>8.4 1.8 19.2</td>
<td>98</td>
<td>113.73</td>
</tr>
<tr>
<td>C</td>
<td>5.2 1.0 13.2</td>
<td>97</td>
<td>74.75</td>
</tr>
</tbody>
</table>

A--Growers (9) received no advice
B--Growers (4) received occasional advice.
C--Growers (12) received advice and recommendations.
I=Insecticide, M=Miticide, and F=Fungicide
*--Insecticide, miticide, and fungicide

Table 3.--Growers joining IPM Farm Advisor Program in 1976. Five farms representing approximately 1,500 acres.

<table>
<thead>
<tr>
<th>Year</th>
<th>Pesticide* cost/acre</th>
<th>Dose equivalent</th>
<th>% clean fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Insecticide</td>
<td>Miticide</td>
</tr>
<tr>
<td>1975</td>
<td>106.14</td>
<td>6.8</td>
<td>1.9</td>
</tr>
<tr>
<td>1976</td>
<td>71.55</td>
<td>3.7</td>
<td>0.6</td>
</tr>
</tbody>
</table>

*Insecticide, Miticide, Fungicide

Table 4.--Growers leaving IPM Farm Advisor Program.

<table>
<thead>
<tr>
<th>Grower</th>
<th>Year</th>
<th>Pesticide* cost/acre</th>
<th>Dose equivalent</th>
<th>% clean fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Insecticide</td>
<td>Miticide</td>
</tr>
<tr>
<td>A</td>
<td>1976+</td>
<td>$ 82.22</td>
<td>3.9</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>1977</td>
<td>99.02</td>
<td>7.3</td>
<td>1.8</td>
</tr>
<tr>
<td>B</td>
<td>1975+</td>
<td>96.14</td>
<td>4.6</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>1976</td>
<td>123.84</td>
<td>8.4</td>
<td>1.1</td>
</tr>
</tbody>
</table>

*Insecticide, Miticide, Fungicide
+Year in IPM
Other Results
The IPM Program is based upon continuous monitoring of orchards for pertinent weather data, pests, chemical residues, and beneficial organisms. Many monitoring tools and techniques were developed and tested in the course of the program. Results of some of these investigations follow.

Apple Scab Ascospore Maturity
Current pest management strategy for apple scab is based upon prevention of primary infection by the ascospore stage. For correct decision making, a pest manager must know the relative maturity of the ascospores in the overwintering leaves and the potential for their release during a wetting period. Other pertinent information, such as the length of the wetting period, the temperature during wetting, and the number of spores released, all aid in determining whether a scab infection took place and its severity. In 1975, the IPM Program initiated a series of scab spray advisories to agents, growers, and fieldmen. The advisory complemented some of the excellent information already being provided via researchers and extension specialists. A computer model for predicting ascospore maturity was established. Accurate predictions of the potential for spore release were made on a routine basis through the use of a "shooting tower" in which overwintering leaves harboring the mature asci were subjected to a simulated rainfall. Examinations of tapes and rods from various spore traps provided information on the relative abundance of spores released during rains. Leaf wetness meters and thermographs were used to determine if and when infection periods occurred. All of this information, together with weather forecasts, provided a sound basis for an assessment of the need for a fungicide application for scab control either before or after a rain.

Tolerance-Resistance
In recommending pesticide applications, every effort was made to select chemicals which would delay the occurrence of resistance. For example, benomyl is an effective fungicide for the two major apple diseases, apple scab and powdery mildew. Beginning in 1976, the effects of benomyl on disease organisms as they appeared on each farm were carefully monitored. Specifically, we were looking for resistance of apple scab to benomyl. Resistance was not observed in 1976, but did appear on one pest management farm in 1977. The information from this monitoring effort was useful, not only during the growing season, but also in selecting chemicals for use during the season at an early time. Growers were encouraged to use a fungicide program which would delay or prevent this resistance from occurring. In addition, known insect and mite resistance problems were managed by recommending insecticides and acaricides known to be effective against the resistant strains.

ANALYSIS OF IPM FOR NEW YORK

Grower Differences
As might be expected, every grower surveyed manages his operation in a slightly different manner. Some growers are completely involved in the business, marketing, and labor aspects of their operation and prefer to leave the spray decisions to their fieldman and agent. Only a few growers have the time and interest to adequately monitor and inspect for pest activity on their farm in order to make optimal pest management decisions. In the farm advisor program, each grower enrolled for his own reasons. Some were corporate farms where pest management was judged to be a profitable investment. Others joined because they valued having someone on their farm every week for careful inspections. Small farmers joined because they could not get the intensive advice and direction anywhere else. Still others joined to see if there was, in fact, something to be gained. Many of these growers added new acreage in the following years. In general, growers were looking for organization, current information, and an opportunity to discuss their own crop protection problems with a person whose livelihood was based on knowing what was happening. They also were looking for definitive answers to their specific situation as opposed to the hedging generalizations offered by other sources.

Much of the success of the IPM program can be at-
tributed to knowing how to approach each grower with the facts, knowing where and when to reach him, knowing what to say to him, and knowing how he will react to the information given to him. Successful IPM in New York is based upon knowing the grower and his operation well.

Chemical Fieldman

From the initial inception of IPM, the program has faced opposition from the chemical fieldmen. In New York, this corps of individuals was the only one offering advice and recommendations to growers on an individual basis. The fieldmen saw both the farm advisor approach and the pest management assistant approach as a threat to their livelihood. They blamed reduced pesticide sales and the increase in grower pesticide bidding, on the IPM program and claimed that IPM and tax dollars were providing subsidized competition.

In each of the succeeding years of IPM, efforts were made to enlist the support and cooperation of the fieldmen. Through much dialogue and participation in advisory committees, the opportunities for the chemical fieldman and IPM to work together are beginning to take form. Workshops designed specifically for fieldmen have been conducted. They are now participating in the computer based information delivery system. Fieldmen have been encouraged to reconsider their approach to serving growers.

Benefits of IPM

Without a doubt, growers who have been involved in IPM have reaped economic benefits from reduced pesticide costs. At the same time, they also have reduced their equipment costs through fewer applications and less wear and tear on their machinery. Where used, IPM has also meant reduced environmental contamination and less exposure of all forms of life to pesticides. The extent to which resistance to pesticides has been lessened is not easy to document. However, the presence of many beneficial organisms and the apparent delay in the appearance of resistance in pests known to be resistant to chemicals in other fruit regions suggests there has been a delay in the onset of resistance.

A good indicator of the benefits of IPM is the return of over 90 per cent of the growers each year to the Farm Advisor Program. Obviously, if the growers were not satisfied, they would not remain in the program. In addition, an increasing number of growers ask to join the Farm Advisor program each year.

FUTURE NEEDS

Operation

The operation of the current Tree Fruit IPM Program is still in its developmental stages. New developments and breakthroughs are on the horizon and can be applied if certain needs are met. Central to much of the program, and of great need, is a comprehensive sampling scheme combined with realistic economic thresholds. While the present schemes are feasible, new efforts would increase the ability of a grower or fieldman to survey and understand an orchard situation. This might mean a reduction in the complexity of IPM, or an increase in the amount of acreage a fieldman could successfully survey.

For IPM to successfully continue to develop, it is essential that a core program for testing, evaluating, and examining new tools and concepts be maintained. This core or demonstration program, similar to what is now the farm advisor approach, will permit the integration of the ideas of all disciplines in a comprehensive program for growers. The core program is also essential for training personnel in the complexities of applied orchard pest management. From this core program, the successes will radiate to all growers, agents, and fieldmen in the State.

Needs

Until now, the tree fruit IPM project has emphasized management of insects, diseases, and mites. While people in other disciplines have shared their time and interest, they have yet to become full-fledged partners in the IPM project. There is a need for greater input from the disciplines of weed science, agricultural engineering, pomology, economics, natural sciences, and atmospheric sciences. As new strategies and approaches are conceived, there is a danger that they may be offered to growers before they have been evaluated for their interactions with other pest problems. The problems of rodents, weeds, weather, and other pests should be addressed more diligently in the integrated approach to crop protection and production.

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