Integrated Pest Management for Apples in the Hudson Valley:

Successes, Constraints, Current Projects, and a Historical Review

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INTRODUCTION

Scientists at Cornell's Hudson Valley Lab and Cooperative Extension fruit agents in Ulster and Columbia Counties have contributed to the development of integrated pest management (IPM) strategies appropriate for eastern NY apple growers. Scientists stationed at the Hudson Valley Lab (HVL) are members of their respective departments at the NY State Agricultural Experiment Station at Geneva. As a result, HVL scientists benefit from close contact and cooperation with

other Cornell faculty and staff involved in fruit IPM programs. However, many IPM strategies developed for the western NY apple industry needed modifications before they could be applied in eastern NY. The responsibility for making appropriate modifications frequently has been left to HVL scientists and eastern NY fruit extension agents. In more than a few cases, HVL scientists pioneered IPM strategies that later were later adopted throughout New York and New England.

Cooperative extension agents, fruit growers, and consultants throughout New York, New England, and other surrounding states recognize the Hudson Valley Lab as a valuable source of practical and reliable information concerning pest management in fruit orchards. Indeed, pest managers throughout New England rely on HVL and other Cornell scientists for research on pesticide efficacy because most of these states no longer have research programs on chemical pest control.

Scientists at the Hudson Valley Lab may be well regarded outside the state, but they have done less well at communicating with their Cornell constituency. HVL scientists have used many sources of funding to finance their research on pest management strategies for tree fruits. As a result, progress reports and research results have not always been funneled through the Office for Integrated Pest Management at Geneva. Benefits of IPM work completed in eastern NY sometimes go unrecognized by those not directly involved in apple pest management at the grower level.

IPM-related programs of Cooperative Extension agents in eastern NY have also received relatively little publicity or recognition within the state. This situation may have developed, at least in part, because eastern NY fruit agents generally have less direct contact with Geneva research faculty and IPM coordinators than do fruit agents in the western part of the state. (Geneva faculty quickly discover that Wayne and Orleans Counties are closer than the Hudson Valley and are therefore more convenient places to conduct applied research.)

On the following pages, we have attempted to summarize some of the successes, constraints, current IPM-related research and extension, and previous history of fruit IPM efforts in eastern NY. This document should serve both as a source of useful information for those interested in fruit IPM in New York State and as a stimulus for further discussion of how to improve fruit pest management research and extension efforts in eastern New York.

SUCCESSFUL PROGRAMMING IN FRUIT IPM RESEARCH AND EXTENSION: AN EXAMPLE

Scientists at the Hudson Valley Lab, Cooperative Extension agents, and the IPM extension specialist collaborated to produce a successful fruit IPM program for the Hudson Valley during the late 1980's. The program consisted of a series of grower educational meetings during winter and spring followed by IPM field meetings at critical junctures during the growing season. The meeting schedule for Ulster County for 1987 is shown below as an example. Similar meetings were scheduled in Columbia county.

February 3-4, 1987	Hudson Valley Fruit School
March 9, 13, 1987	Hudson Valley "Do-It-Yourself" IPM Program
April 20, 1987	Prebloom IPM Strategy Meeting
May 18, 1987	Postbloom IPM Strategy Workshop
June 3, 1987	IPM Field Meeting
July 1, 1987	IPM Field Meeting

The Hudson Valley fruit school was organized by the extension agents. Scientists from Ithaca, Geneva, and the Hudson Valley were invited speakers and presented the latest results of their research. The March "Do-It-Yourself" IPM Program was publicized through traditional extension channels but was directed by Jim VanKirk, the regional IPM extension specialist who was located at the Hudson Valley Lab at that time. VanKirk and HVL scientists provided more detailed information on pest biology, how to monitor for pests, and how to implement IPM strategies.

Four "twilight" meetings were held in Ulster and Columbia Counties to discuss pest control strategies for the prebloom period, the early postbloom period, the beginning of summer sprays, and mid-summer sprays. Meeting dates, times, locations, and publicity were handled by the Cooperative Extension agents. Most of these meetings were held in orchards during the late afternoon. VanKirk demonstrated scouting techniques and insect traps. He also reported unusual pest problems observed in commercial orchards during the course of his IPM implementation work. Rick Weires, HVL entomologist, and Dave Rosenberger, HVL plant pathologist, discussed pest management strategies and provided examples of pests that growers might expect to see. Agrichemical field men were usually present with valuable questions, insights, and information on strategies that appeared to be working well and strategies that were proving unsatisfactory. The Cooperative Extension agents reiterated responses to recurring questions they had been receiving over the telephone. The extension agents were instrumental in keeping the meetings moving and effective; they sometimes prodded participants to clarify recommendations or expand on points that the audience might have missed otherwise. Meetings were well attended and the discussion was often lively.

The series of summer IPM strategy meetings probably had their greatest impact during the summer of 1989. Apple growers had been scarred by the Alar Scare and were groping for alternatives to pesticides that might leave unacceptable residues on fruit. Captan, mancozeb, and benomyl were considered risky because no one knew which compound might be the next "Alar". At the same time, mite control was becoming increasingly difficult because of populations showing resistance to common miticides. The summer field meetings were held on a schedule similar to that shown for 1987. Weires picked up much of the slack left by the departure of VanKirk. The IPM field meetings provided growers with the best information available at the times when the information could be immediately applied.

In 1990, this kind of IPM programming proved impossible. Weires was ill, Rosenberger was on sabbatical leave, and the IPM extension specialist was relocated to the Albany area.

Can this kind of IPM programming be revived and/or improved? The success of the program used in this example was largely dependent first, on the organizational impetus provided by the IPM specialist, and second, on the interest of growers. No one has filled the gap left by the departure of VanKirk. Fruit grower interest in pest management remains high, but labor and marketing issues are also competing for attention. Some aspects of fruit integrated pest management are still alive and well in eastern NY, but various constraints have limited further development of fruit IPM. Some of the constraints are outlined below.

CONSTRAINTS FOR FRUIT IPM PROGRAMS IN EASTERN NY

Unique aspects of the Hudson Valley and eastern NY fruit industry: The Hudson Valley climate, pest complexes on fruit, and marketing strategies of its fruit growers are considerably different from those in other parts of New York State. The climate in the Hudson Valley is warmer and more humid. As a result, Hudson Valley fruit growers encounter many pests

that are relatively unimportant or uncommon in western New York. On apples, these include cedar apple rust, quince rust, sooty blotch, flyspeck, bitter rot, potato leafhopper, apple blotch leafminer, European apple sawfly, and higher levels of plum curculio and white apple and rose leafhopper. In most years, ignoring these pests in the Hudson Valley virtually assures a significant loss of fruit quality and/or quantity. Unfortunately, researchers and IPM specialists working in other parts of the state tend to forget the significance of some of these pests, and they have contributed relatively little to the development of regionally appropriate IPM strategies that include the full complement of pests present in eastern NY.

Eastern NY fruit growers have traditionally produced fruit almost exclusively for fresh market sales. Fruit unsuitable for fresh market are diverted to processing or juice, but few eastern growers produce apples with the express intent of sending them to processing. As a result of their focus on fresh market sales, fruit growers in eastern NY recognize that even very low incidences of defects in fruit may cause sizable monetary losses. Unlike producers in many other apple production areas, most eastern NY growers do not perceive the processing market as a desirable alternative for blemished fruit. Higher costs for land, taxes, and labor in the Hudson Valley as compared to western NY fruit-growing areas may also contribute to concerns about pest-induced losses. Thus, tighter operating margins and a lack of profitable outlets for blemished fruit both contribute to the reluctance Hudson Valley fruit growers may show when confronted with risks inherent in some of the more 'progressive' IPM practices which have been proposed.

Many fruit growers in the Hudson Valley store and pack their own fruit. They may be more conservative in their pest management practices than are similar growers who have their fruit packed by someone else. Growers packing their own fruit are reminded of pest control deficiencies in their previous year's program every time they see a culled fruit drop into the cider bin a the end of the packing line. They observe directly the reasons for low pack-outs. Thus, they are often better able to fine-tune their pest management strategies than is a grower whose fruit is packed at a central warehouse and who receives no detailed breakdowns on reasons fruit were culled.

The unique aspects of the Hudson Valley fruit industry noted above (and perhaps others we have failed to recognize) form the dynamic economic and management framework within which effective IPM programs must operate. Apple IPM strategies that don't fit within the framework will not be adopted by the majority.

Availability of IPM consultants in eastern NY: Private IPM consultants represent an important link in moving IPM strategies from the research and demonstration stages toward full implementation. Unfortunately, availability of private IPM consultants in eastern NY continues to be a limiting factor. The lack of private consultants has stymied previous Cornell attempts to establish IPM scouting programs in the Hudson Valley. In 1987, VanKirk, in a presentation to Hudson Valley growers noted that a goal of the statewide IPM program has been to "...provide implementation funds for a finite period of time, usually about three years, after which the program is left to stand or fall as either a private business, grower cooperative, county program, or some combination of the three." It was assumed that after a successful demonstration, the private sector would fill the void as Cornell withdrew resources from the program. This philosophy is further illustrated in the 1988 report, *Summary of Recommendations from the Fruit Commodity Committee* regarding the previously funded Hudson Valley Pome Fruit IPM Farm Advisor Program: "This project is now completely financed by the industry, and the project leaders and (the) industry should be commended for their support of this IPM effort, which was initially funded by this program. Hopefully, those involved in this scouting service will consider testing some of the

formalized sampling procedures, which are currently being tested in western NY ... in cooperating grower orchards."

This report cited above suggests that IPM technology for fruit was in place in the Hudson Valley in 1988. However, the program became virtually invisible after VanKirk left the area because no one was left to nurture and refine the technology. (The stated assumption that private consultants should take responsibility for testing and verifying sampling procedures and thresholds also needs further examination.) A lack of private consultants severely limited growers' abilities to implement IPM.

Inability of the private sector to continue IPM program development: A significant portion of Cornell's IPM resources during the 1980's was directed toward getting IPM programs started. The assumption was that growers and private consultants would quickly adopt IPM practices. Costs of up-grading and implementing new IPM practices were then to be covered by the private sector. The perception that IPM practices can be "implemented", then left to the private sector, has resulted in considerable frustration within Cooperative Extension and among growers.

The weakness in this approach was the failure to recognize IPM as a dynamic technology that requires continual research, up-grading, and fine-tuning. IPM research continues at the Hudson Valley Lab and elsewhere within the Cornell system, but the personnel for up-grading and fine-tuning the applied process of IPM management are not in place. Private consultants, even if available, may be unwilling and/or unable to assume the responsibility for up-grading thresholds and sampling methods appropriate for large-scale applications. Thus, a gap exists between IPM research and the process of fine-tuning new research findings into existing fruit IPM strategies for eastern NY. Responsibility for continual fine-tuning of IPM strategies might be considered part of the job of the county fruit extension agent. However, the work of fine-tuning and testing IPM strategies would more likely receive adequate attention if an IPM specialist was assigned this responsibility.

Personnel changes at the Hudson Valley Lab: IPM efforts in the Hudson Valley have been constrained to some extent by limitations on available personnel. A nascent but effective fruit IPM program was terminated when IPM specialist Jim VanKirk moved from the Hudson Valley to another assignment. His replacements became increasingly less effective, at least in part because of poorly defined objectives and constraints on the kinds of projects that were given priority.

A major transition in programs and personnel at the Hudson Valley Lab began in 1990, and the transition sapped considerable strength from existing programs. Rosenberger was on sabbatical leave in 1990. Rick Weires was ill and died later that year. Chick Forshey retired. Mark Castaldi resigned early in 1991. Exactly one-half of the total personnel employed at the lab in August of 1990 were still present by March of 1991. The laboratory facility itself was run-down from several years of neglected and postponed repairs. Orchard research was further disrupted in 1991 by the construction of a new pesticide storage and containment facility in the research orchards at the Hudson Valley Lab.

Two faculty positions, two technical positions, and the extension economist position remain unfilled as of March 1993. (The faculty and technical position in Horticulture should be filled by mid-1993.) Straub's willingness to move from vegetable entomology to fruit entomology reduced the potential impact of losing Rick Weires, but even an experienced entomologist like Dick Straub needed time to learn the intricacies of pest management in a new commodity. Throughout the transition, Rosenberger has been forced to redirect considerable effort to

administrative responsibilities. Administrative duties include not only those inherent in any major transition (hiring and orienting people to new responsibilities), but also extra work associated with the construction of the new pesticide storage and providing direction for the needed repairs and improvements in the laboratory facilities.

We are currently emerging from the transition period began in late-1990. Personnel at the Hudson Valley Lab should be able to contribute more effectively to state-wide IPM efforts in the future than has been possible over the past four years. We hope to dispel the perception that resident scientists and fruit agents are 'hostile' to the principles of IPM. It is important, however, to clarify expectations and responsibilities of the HVL scientists, eastern NY fruit agents, and the IPM group at Geneva vis-a-vis IPM implementation and research in eastern NY.

Existing structures and expectations imposed on Cooperative Extension fruit agents: Cooperative Extension fruit agents working at the county level suffer from a lack of clear leadership and lines of authority. The extension agents must meet the expectations of their county extension association, their grower clientele, Cornell extension administrators, and Cornell scientists working on cooperative research and demonstration programs. These four groups frequently have different and conflicting goals. The director of the county extension association is the nominal supervisor for the fruit agent in each county. Association directors expect fruit agents to participate in local association activities, but these activities may adversely affect time and effort that can be directed toward the fruit program. Cornell extension administrators have additional and different expectations (such as a regional fruit team), but they currently lack the financial incentives to make their programs attractive to either the agents, the grower clientele, or the county coordinators, any one of whom could influence the current directions of fruit extension programming. Growers have traditionally relied on Cooperative Extension agents as a ready source of information, and they may be reluctant to accept reduced access to their fruit agent in exchange for the research and demonstration programs which Cornell administrators consider the responsibility of agents. Fruit growers and county extension associations have proprietary interests in keeping fruit extension programs county-based.

Despite conflicts in expectations and leadership, fruit agents in the Hudson Valley have succeeded admirably in promoting IPM concepts and disseminating IPM information. (Specifics of their programs are outlined below.) They have succeeded less well in meeting Cornell's expectations for conducting IPM demonstration projects, a situation that will likely continue until agents are incorporated into an eastern New York extension fruit team and removed from some of the distractions inherent in county extension programs.

CURRENT IPM-RELATED ACTIVITIES IN EASTERN NY: COUNTY EXTENSION PROGRAMS

Columbia County Fruit Extension Programs — Craig Telgheder

Educational programs: The Cooperative Extension fruit program in eastern NY has contributed significantly to the adoption of IPM practices by commercial fruit growers. Numerous meetings, seminars, workshops, and radio and recorded message programs have explained and demonstrated IPM techniques and practices.

- Daily/weekly radio and recorded message programs represent the most successful method of delivering IPM information. These programs are the most popular among growers and have significant impacts because of the timeliness of information and constant adjustment of strategies based on observations and conditions. The flexibility of daily delivery allows for the

greatest exploitation of IPM methods because changes and revisions can be made quickly. Information on pest status, biology, thresholds, various methods of control, and cultural practices is presented. The value of these programs extends beyond the immediate benefits to the commercial fruit growing audience. Many other non-farm listeners gain an appreciation for the complexity of pest management and the amount of technical information required to make good pest management decisions.

- In 1992, a total of 112 individual radio and recorded message programs were delivered to audiences in Columbia, Dutchess, and Rensselaer Counties. In addition to the general audience of radio listeners, 45-85 callers listened to the recorded message on a code-a-phone.
- Telephone call-in periods after the daily radio program offer further opportunities for IPM education. Phone consultations often deal with very specific pest problems and require specialized solutions that work along with other management strategies. There is at present no formalized IPM program that can deliver this level of specificity. Pest management related calls number 250 - 425 per month during peak decision-making periods.
- The Cooperative Extension newsletter *Hudson Valley Fruit News* delivers information on IPM recommendations, pest status, biology, thresholds, and control. Approximately 750 copies of this newsletter are distributed to commercial growers, industry members, and others throughout the growing season.
- On-farm troubleshooting calls are an effective IPM delivery method because of the excellent educational opportunity provided by the existence of the 'problem'. During these calls, growers lacking information on some aspect of identification, biology, or control are motivated to find and remember information relevant to resolving their problem. The opportunity allows for customizing particular IPM methods for the grower's management style, market, tolerances, and needs and increases the likelihood that the grower will adopt the suggested IPM methods.
- The annual Hudson Valley Fruit Growers School provides pest management information based on the most recent research findings.
- A Hudson Valley Grape Growers School was held in 1992 to educate grape growers on IPM methods available for that crop, as well as other topics.
- Regional meetings in cooperation with the NYS Berry Growers Association have taken place in the Hudson Valley to update growers of small fruit crops on available IPM methods and other topics.
- A workshop on resistance management was provided to Hudson Valley fruit growers to inform them of strategies that they can employ to reduce the potential for insecticide/fungicide resistance and thus preserve tools used in IPM programs.

<u>Research/Demonstration Efforts</u>: Demonstrations of IPM methods have taken the form of dedicated, endorsed NYS IPM projects and educational workshops, and projects that have been performed without formalized leadership from the IPM program. The current perception of the Hudson Valley fruit producing region being "non-IPM" has likely been fostered because of the latter projects noted above. The lack of an IPM specialist has also reduced the communication of Hudson Valley IPM involvement. A listing of some of these projects is as follows.

- Annual field meetings are held as prebloom 'pest strategy' workshops and postbloom updates as needed. University, Experiment Station, and Extension staff deliver up-to-date information on

pest management considerations during these meetings. Separate meetings are occasionally held for apples and pears.

- The computer model Maryblyt has been tested in the Hudson Valley and will continue to be tested and adapted for local use. The use of this model will ultimately result in better control of the disease fire blight by apple and pear growers. The model will allow quantification of the factors involved in disease development, and create an objective rationale for applying sprays to control it. Resistance to streptomycin, presently the only practical means for control, will ideally be avoided because of greater precision in disease control timing and frequency.
- 'Integrated Biological Management of Arthropod Diseases and Insects of Apple' is a cooperative experiment with the Ciba-Geigy Research Station in Livingston, NY. This project is a three year study looking at integration of many IPM methods and their effects on "commercial" orchards. Completion is scheduled for Fall 1993. Funding was provided by the NYS Apple Research and Development Fund.
- Evaluation of 'Agrimek' for pear psylla control: Field plots were established in Columbia County to evaluate this new material in terms of efficacy and it's potential as a tool to enhance IPM strategies. The minimal funding needed was provided by the manufacturer.
- Weather monitoring equipment is maintained and read on a regular basis during the growing season to aid in monitoring disease development and to assist in providing pest management recommendations to fruit growers.
- Insect trapping at the Ciba-Geigy research block aids in monitoring pest development and incidence. Trapping also assists in providing pest management recommendations to fruit growers.

Ulster County Extension Educational Programs — Warren Smith

Radio programs for Ulster/Orange County Commercial Fruit Growers: Fruit grower radio reports are a key component of the Cooperative Extension Fruit Program. The reports were initiated by Extension Agent Bill Palmer in the 1950's and continue today as a successful program delivery tool. Radio reports are heard by all commercial fruit growers in the lower Hudson Valley. The success of the program is apparent from grower response to meeting announcements and to recommendations. Program impact is also evident from the number of phone calls and the type of questions received from growers during the "problem solving sessions" held after the live radio broadcasts. Beginning in 1991, radio station WRWD-FM became the only station to broadcast the reports in Ulster/Orange Counties, and year round daily reporting was initiated. The continuity of year-round programming has improved overall impact.

The purpose of the fruit grower radio reports is to provide timely and accurate pest management and cultural practice recommendations. During the growing season, live reports are aired weekdays at 6:20 AM. The live radio reports incorporate a daily weather forecast provided by the National Weather Service at Albany, NY. The weather forecast is customized for fruit growers in the lower Hudson Valley during a 6:00 AM conference call between the NOAA meteorologist in Albany and the two fruit agents in eastern NY. The timeliness and accuracy of the weather forecasts enhance our ability to recommend realistic IPM strategies. Because the growers hear the IPM messages daily and at a time when they are most likely to follow the strategy discussed — just before taking an action to control pests — the potential for impacting pest management decisions is considerable.

Some IPM strategies have been adopted in part because of the educational information provided by the radio reports. Apple growers have gradually changed their control strategies for apple maggot. Rather than applying treatments beginning with first emergence of the apple maggot pest, growers now consider individual orchard historical data, current pack-out information, proximity of commercial orchards to abandoned orchards, and most importantly, the results of apple maggot trapping. IPM data shows that first fruit damage is associated with peak maggot emergence not first emergence. Radio reports help growers keep abreast of maggot emergence and activity in other orchards and provide them with a double-check for what they are seeing in their own orchards.

The fruit industry radio reports not only affect the profitability of growers but also benefits Cooperative Extension by generating public awareness of programming efforts. Cooperative Extension credibility is reinforced because of our daily presence in the "public eye" via the radio. The IPM message is delivered to growers as well as the public who are concerned with food safety, environmental quality and worker protection. Bud Walker, who is a fruit grower, president of Walker Broadcasting, and owner/operator of radio station WRWD, states that the fruit reports provide the general public with information that helps them better understand why fruit growers spray orchards and follow other farming practices. He considers the radio reports vital to public acceptance of IPM strategies.

Current Arbitron survey data for WRWD shows that in the primary listening area of Orange, Ulster, Dutchess and Sullivan counties, there are 676,700 potential listeners over the age of 12 and that 83,000 adults over age 18 hear the fruit report during the prime-time morning listening period. Other regions that are also reached by WRWD include areas in Greene, Columbia, Westchester, Rockland, and Putnam counties plus areas in western Connecticut and Massachusetts.

Code-a-Phone Messages for Ulster/Orange County Commercial Fruit Growers: In 1989, a telephone line dedicated to a code-a-phone message delivery machine was installed in the Extension Office at the Hudson Valley Lab. Telephone number 914-691-7173 is reserved for the delivery of IPM messages and other information of value to growers via code-a-phone. The code-a-phone is operated from April 1 through October 31. Messages are up-dated daily during spring and early summer and once or twice a week during the remainder of the year. Information disseminated via the code-a-phone includes current field observations, input from HVL staff, comments from local field men, grower observations, and information received from other sources including "Scaffolds-The Geneva Exp. Station Fruit Journal", edited by A. Agnello and D. Kain. The code-a-phone unit has a counter that provides an accurate record of number of calls received. From April through July, code-a-phone use averages 35-40 calls with a high of 60-65 calls on some days.

Activities used to teach IPM in Ulster/Orange Counties in 1992: Educational activities used to teach IPM practices included nine newsletters, daily code-a-phone messages for the period April 1 through October 31, daily radio broadcast for the period April 1 through June 20, two IPM focus meetings, one major fruit school event, and numerous telephone consultations and farm visits. Advisory groups, individual growers, and agribusiness associates estimate that 11,000 acres of fruit production, or nearly all commercial production in the two county area, were impacted by these activities.

CURRENT IPM-RELATED ACTIVITIES IN EASTERN NY: RESEARCH AT THE HUDSON VALLEY LAB

Entomology Research/Demonstration Projects — Dick Straub

Following are brief descriptions of IPM research and extension projects currently under way in the Hudson Valley. Publications resulting from each project are noted by numbers in parentheses and are listed at the end of this study document.

Management of the plum curculio with a predictive oviposition model and border sprays: This multi-year project involving the Hudson Valley Lab in Eastern NY and the Geneva Experiment Station (Drs. Reissig and Nyrop) was initiated in 1990 and will continue at least through 1993.

In the Hudson Valley, early-season sprays starting at petal-fall or earlier are necessary to limit the damage caused by curculio oviposition and feeding scars. Growers typically apply from 1 to 3 sprays aimed primarily at curculio. Within this cooperative project we are gathering ovipositional data in order to develop a forecast system to advise growers precisely when they may stop spraying to prevent immigration and subsequent damage. Our model for temperature-dependent cumulative feeding and oviposition is based on degree days above a 50 degree F threshold accumulating after petal fall of 'McIntosh'. After two years of study and validation, the cumulative damage predicted by our model was delayed, compared to observed values; efficacy data showed that a 150 DD delay in the first insecticide application was too long, allowing excessive damage; and that curtailment of insecticide applications once the 40-50 percentile point on the cumulative damage distribution was reached, provided control as effective as an additional cover spray.

Because dispersal of the curculio is limited and most fruit damage is commonly confined to the outside rows of an orchard next to wooded areas, we are investigating the potential for managing this pest by spraying only the perimeter of an orchard, after having first eliminating resident curculios by a total orchard spray. If successful, this tactic could reduce the total lbs. of insecticide currently directed against this pest. After two years of experimentation in small plots we have concluded that this is a potentially sound management tactic for curculio alone, but in the Hudson Valley we have experienced unacceptable damage in the orchard interior from plant bug, which has greater migratory mobility.

We will continue to evaluate, in grower blocks, reduced insecticide schedules based on oviposition model predictions and perimeter treatments. We are cognizant however, that in the Hudson Valley, successful omission of sprays against curculio may allow increased damage from other fruit pests such as plant bug and European apple sawfly. The extent of that damage is currently being assessed. [Initiated 1990; supported by NY Apple Research and Development Program].

Management of fruit-feeders using seasonal applications of 'soft' insecticides: Growers presently apply two relatively 'soft' phosphate insecticides, Guthion and Imidan, at various times throughout the season. Both are considered to be effective against fruit-feeders and are reasonably safe on natural enemies. Imidan is relatively good with respect to applicator safety and most growers would prefer to use this material over Guthion, but have questions about initial toxicity and residual activity against the entire complex of fruit-feeding apple pests. This project was designed to test these factors by applications of both materials on 14 day and 21 day schedules from petal-fall to near harvest. In general, there was little difference between the 14 day (8 applications) and 21 day (5 applications) schedules, suggesting that fruit can be protected with wider than normal application intervals. In comparisons of the two insecticides, Guthion provided significantly better over-all control of fruit feeders, with even the 5 application Guthion schedule performing better

than the 8 application Imidan schedule. It is suggested that if growers select Imidan for the increased margin of worker safety, they might expect ca. 4% greater damage from fruit-feeders, particularly curculio, plant bug and European apple sawfly. This set of experiments will likely continue until 1994. [Initiated 1992; supported with program funds].

Use of a botanical insecticide for management of foliar and fruit-feeding pests of apple : Margosan-O (commercial formulation of an extract of neem, Azadirachta indica) is a naturally occurring insecticide that has legendary properties of ovipositional deterrent, anti-feedant, growth regulator, etc. Preliminary evaluations of neem in a seasonal program against apple pests showed poor activity against fruit-feeders, but remarkably good activity against two major foliar-feeders, i.e., the leafhopper complex and the leafminer complex. A subsequent study showed the same results, but additionally indicated that substitution of Guthion at petal-fall for curculio and a tank-mix with Guthion during the peak apple maggot season provided adequate control of the major fruit and foliar-feeding insect pests. Further demonstration of this potential could provide a very good seasonal recommendation for growers who desire a season-long regime that is protective of key natural enemies. These experiments will continue until at least 1994. **(125)** [Initiated 1991; supported by agrichemical companies and program funds].

Determination of the damage potential of the leafhopper complex on apple: Our initial investigations showed that the white apple leafhopper (WALH) is not the sole indigenous leafhopper species on apple, as was previously believed. We determined that the rose leafhopper (the first generation of which is spent on wild and cultivated rose; the ensuing two generations on apple) may well be more important than the WALH because of numbers and the greater potential for damage. We thus now believe that the typical 1-2 insecticide treatments directed against first generation WALH are unnecessary. Treatments can be delayed until mid-June when both species are present, thereby making optimum use of insecticides . Subsequent investigations within this project will lead to further revision of recommendations as we learn about the physiological effects of leafhopper damage under irrigated and non-irrigated regimes, the alternate-host origin of the rose leafhopper and precise timing of insecticide applications for leafhopper management. This project is due to be competed in 1998. **(44, 230).** [Initiated 1991; supported by NY Apple Research and Development Program] .

Leafminer damage and the leaf/fruit ratio of size-controlled cultivars: Results of previous research in NY demonstrated that severe damage by the leafminer(s) causes premature drop of standard 'McIntosh' and contributes to reduced fruit set/crop load on other standard cultivars. It is reasonable to suspect that similar effects on cultivars grown on size-controlled rootstocks are even more pronounced. Results of a study in the Hudson Valley during 1992 showed that severe premature fruit drop within a block of M.9/'McIntosh' was due to leafminer damage that exceeded a level of 6 mines/leaf. Through measurements of the leaf/fruit ratio, we determined that it was two-thirds less than the ratio reported as optimum for standard cultivars. Subsequently, we found that the 6 mines/leaf damage level contributed to 25% loss of leaf function, which in effect reduced the ratio even further from optimum. Results of preliminary economic analysis revealed that damage by leafminer caused 80% reduction in harvestable fruit and contributed to > $2000/acre loss in revenue. We are expanding the study to gain information relative to the inherent and unique leaf/fruit ratios of size-controlled trees planted to high densities and the propensity of leafminer to alter those ratios. Results will enable extension and IPM personnel to better assess the impact of leafminer infestation levels in high-density planting systems. This project is expected to take 3 years. [Initiated 1992; supported by program funds, grant request pending with NY Apple Research and Development Program.]

Enhancement of naturally-occurring predacious mites in a minimal-spray orchard: Starting in 1992, a block of 164 mixed 'Empire' and 'Liberty' on M.9 rootstock was treated season-long with Imidan for control of insect pests. Pest mite and predacious mite levels were monitored twice during the month of August. Populations of European red mite and two-spotted mite had risen above the threshold of 7.5 mites/leaf during early-August, but by the end of August, this population was reduced to 4.3 mites/leaf, apparently due to predation by Amblyseius fallacis (0.1/leaf) and Zetzellia mali (0.02/leaf). Although insect damage allowed by the Imidan program was excessive, this study during the first year was encouraging relative to the benefits of protecting the two species of predacious mites. This long-term experiment will continue for an indefinite period of time and will investigate the addition of a 'soft' botanical insecticide (neem extract) during periods of high leafhopper and leafminer activity. **(45)** [Initiated 1992; supported by program funds.]

Studies on potential insect problems associated with a specific pear psylla insecticide: New York pear growers have recently gained a trans-lamelar chemical that provides season-long protection against pear psylla infestation with a single application ca. 10 days post-petal fall. Since this material provides control of the major insect pest, but has no effect on other lesser pear pests, current studies are designed to determine the extent of damage that might be expected from 'secondary' pests should a grower fail to maintain a protective cover of insecticide residue. Results from 1992 suggest that a single treatment with a phosphate insecticide will be necessary at petal-fall to control plum curculio - failure to do so will likely result in a high percentage of unmarketable fresh fruit. Just as importantly, we found that failure to apply a protective cover(s) during late-August or early-September may result in serious infestations of 'Bosc' by oriental fruit moth. These studies are necessary to establish spray regimes that will both, protect the crop from excessive damage from 'secondary' pests, and reduce the amounts of insecticide required to accomplish that. [Initiated in 1992; supported by program funds.]

Plant Pathology Research/Demonstration Projects — Dave Rosenberger

Development of Sustainable Apple Production Systems for the Northeast: This five-state multidisciplinary project has been funded since 1988 by the USDA's Sustainable Agriculture Program. The project is expected to continue through 1999. Cornell cooperators receive about $50,000 per year to pursue studies on scab-resistant apple cultivars (SRC's) and sustainable management practices for apples. Because Rosenberger, Weires, Castaldi, and Smith were actively involved in initiating the project, most of the project research has been conducted in the Hudson Valley. Five plantings of SRC's were established in the Hudson Valley and are being used for data collection. Dr. Ian Merwin has assumed responsibility for horticultural aspects of the project, Dr. Lois Willett is involved in economic studies, Dr. Sue Brown provides information on new and promising cultivars from the Geneva apple breeding program, and Mike Fargione assists with wildlife damage studies. Project participants have published a production manual **(188)** and a biannual newsletter covering research completed within the project **(157,185, 191)**. Sub-projects within the sustainable apple production project are listed below. Those preceded by an asterisk are directed by Dr. Ian Merwin, but most of the field work is performed by technicians from the Hudson Valley Lab.

Minimizing fungicide sprays for flyspeck through judicious use of Benlate and consequent effects on mite populations: Flyspeck can be controlled effectively with 3-4 applications of Benlate, but it is unclear whether these applications disrupt mite predators. Treatments are being applied to

the same replicated plots for five years and effects on mite populations are being monitored **(120)**. [Initiated 1991.]

Effects of planting density, ground cover management, and fungicide sprays on total yield and on incidence of summer diseases in Liberty apples: Cultural controls for summer diseases are being evaluated along with minimal fungicide programs in a factorial-design experiment in a high-density planting of Liberty. Effects on yield and economics of the various practices are being evaluated. Detailed environmental data is being collected from various tree canopy areas to determine relationships between tree canopy and incidence of disease. Data will be collected for at least 4 years. **(41).** [Initiated 1991.]

Identifying the causes and implications of premature defoliation in apple trees receiving no summer fungicide sprays: Liberty apple trees receiving no fungicides defoliate 2-3 weeks earlier in the fall than do sprayed trees because leaves on unsprayed trees are attacked by an unidentified leaf-spotting fungus. Initial investigations have shown that trees which defoliate early may be more sensitive to chemical fruit-thinning sprays the next season. The identity of the fungus which causes fall leafspot is being determined, and the affect on thinning and productivity is being investigated. [Initiated 1991.]

Early-season leafspot and powdery mildew — Cultivar susceptibility and impact on yield: SRC's including Liberty are susceptible to both powdery mildew and to early-season leafspotting. The latter is caused by cedar-apple rust infections which fail to develop normal rust symptoms **(37)**. The incidence of powdery mildew and rust-induced leafspot is being monitored for 8 SRC cultivars, and effects on yield will be determined over the next several years. [Initiated 1991.]

Using summer copper sprays for controlling sooty blotch and flyspeck: In the wake of the Alar scare, conventional and organic growers alike sought acceptable alternatives to synthetic fungicides. This study determined the limitations of using summer sprays of copper fungicides in apple orchards **(106)**. [Field work conducted 1989-91; final publication in preparation.]

Determining optimum harvest dates and long-term storage potentials for SRC's grown in the Hudson Valley: Maturity indices including firmness, soluble solids, and internal starch levels are measured for fruit from several promising cultivars over several harvest dates. Some fruit are stored in regular and CA storages to assess long-term storage potential. Information on harvest dates and storage potential is needed by growers who wish to plant new cultivars. [Initiated 1991.]

Evaluation of natural and synthetic mulch materials and permanent cover crops for weed control and soil conservation in northeastern orchards:* Various mulches are being evaluated as alternatives for herbicides in five plantings in eastern NY and additional plantings in Ithaca **(156, 157, 159). [Initiated 1989.]

**Evaluation of vole impacts on tree survival under natural and synthetic mulches:* Vole damage and various approaches for reducing it are being studied in mulch plots noted above. [Initiated 1990.]

<u>Studies on prebloom copper sprays applied to control fire blight</u>: Field tests conducted in 1989, 1990, and 1992 showed that delayed-dormant copper sprays applied for fire blight also act as a protectant fungicide against apple scab and therefore eliminate the need for a green-tip fungicide **(117, 191, 215, 227)**. In 1990, copper sprays were applied late and caused extensive fruit russetting and monetary losses in some Hudson Valley orchards **(70, 217)**. Experiments were conducted in 1992 to determine if adding lime to early-season copper sprays would reduce the potential for fruit

damage. Lime proved ineffective for reducing phytotoxicity, but fruit damage was avoided by applying sprays before bud-break **(215)**. By using properly-timed copper sprays, growers should be able to avoid fruit russetting and still get the nutritional and fire blight control benefits of delayed dormant copper sprays. [Initiated 1989; funded 1992 by NY Apple Research and Development Program.]

Wood-rotting fungi causing decline in apple trees and their relationship to canker diseases: Wood-rotting fungi (basidiomycetes) are present in most apple trees over 10-years old, but their role in tree decline has never been studied. We are identifying the predominant fungal species involved and investigating their role in predisposing trees to canker diseases such as black rot canker **(182, 214)**. No pest management strategies are currently available for black rot canker and wood rotting fungi because no one understands when, how, and why infections occur. [Initiated 1989; supported with program funds.]

Forest and shade trees as sources of inoculum for bitter rot in apple fruit in southeastern NY: Bitter rot is a sporadic problem in apples in the Hudson Valley, but it can be controlled only by using high rates of fungicides such as captan. Based on observations made from 1989 through 1992 in an orchard in Long Island **(257)**, we now suspect that the primary source of inoculum for bitter rot in apples may be shade and forest trees around the orchard perimeter. The epidemiology of bitter rot in these perimeter trees could hold the key to predicting when and where protectant fungicide sprays are needed in apples. [Initiated 1992; supported with program funds.]

Studies on minor diseases encountered in fruit trees as fungicide use is reduced: Minor diseases and unknown disorders which were rare in New York orchards 10-20 years ago have appeared with increasing frequency as growers have reduced fungicide use in apple orchards. Current problems under investigation include lenticel spotting which develops on fruit in some low-spray orchards in October, outbreaks of leaf-spotting fungi, and a twig die-back apparently caused by *Microsphaeropsis olivacearum*. Minor and unusual pest problems need to be identified and investigated to ascertain if they are likely to become major problems as spray programs change. In the absence of good information on the causes and controls for new pest problems, growers who have encountered outbreaks of these unusual pests may revert to unnecessarily heavy use of pesticides to prevent recurrence of the problem. **(190, 194, 220)**.

Refining Chemical Control Strategies for Flyspeck on Apples: In studies conducted at the Hudson Valley Lab from 1986-1989, minimal fungicide strategies were devised for controlling summer diseases on apples. Disease control was achieved with monthly applications of benomyl and/or mancozeb, but these fungicide became less acceptable after the Alar scare. Beginning in 1990, ziram and thiophanate-methyl have been evaluated as alternatives for controlling summer diseases on apples. Ziram is not currently listed as a potential carcinogen. It is compatible with summer oils and has less adverse environmental impacts on earthworms and predator mites than most alternative fungicides. Initial studies where ziram appeared ineffective may have been confounded by differences in activity between the two commercial formulations of ziram. The feasibility of using ziram and the effects of formulations, rates, and spray timing will be studied in more detail in 1993, along with other minor adjustments in fungicide application timing which might result in improved control of this disease. **(101, 198, 199, 205, 212, 224)** [Initiated 1990, supported 1993 by NY Apple Research and Development Program.]

Optimizing chemical control strategies for apple diseases: Field fungicide evaluations are conducted each season to provide information needed for chemical control recommendations **(71-124)**. Information from these field trials is incorporated into apple pest management guides and

state IPM strategies in New York and throughout New England. [Annually since 1978; supported by agrichemical companies and with program funds.]

Controlling postharvest decays of apples: Objectives of this project are to determine the causes and epidemiology of postharvest decays in apples in New York storages and the best methods for managing these decays. Appropriate pest management recommendations are essential for minimizing both unnecessary postharvest treatments and losses to postharvest decays. Discoveries over the past 15 years include the first reports that benzimidazole-resistance was wide-spread in decay fungi in apple storages, the first evidence that diphenylamine applied for scald control also controlled benzimidazole-resistant fruit-decay pathogens, and the recognition that several species of *Penicillium* contributed to blue-mold decay in apples storages. Trouble-shooting for growers who encountered unusual fruit decay problems in stored fruit has also been an important part of this project. (**15, 28, 31-33, 40, 42, 43, 74,80, 82, 91, 92, 160, 167,181, 189, 192, 193, 195, 196, 207, 209, 216**). [Initiated 1978; supported with agrichemical grants and Hatch funds].

HISTORICAL OVERVIEW OF IPM RESEARCH AND EXTENSION IN THE HUDSON VALLEY

The following summary of IPM-related projects conducted in the Hudson Valley over the past 15 years is incomplete because many who contributed to IPM projects are no longer available to assist in compiling the summary (i.e., Forshey, Weires, VanKirk, Lawson, Alm, and Cavanaugh). Some activities, especially those relating to orchard scouting, were either never formally reported or the locations of those reports remains unknown.

Columbia County Extension Programs 1982-1988 — Mary Concklin

Meetings, Short Courses, Workshops, Seminars: During the growing season, growers found timely meetings to be valuable for planning their pest management strategies. Meetings such as the informal IPM field meetings that were held every 2-3 weeks were used to inform growers of general pest presence, pressure, upcoming pest emergence, scouting techniques, and pest management options. Examples of insects and diseases were often passed around to educate those growers not familiar with a particular pest and/or stage of development. In addition, research trials were discussed and shown. In the off season, in-depth workshops, seminars, classes, and fruit schools were held to review the past season, provide up-to-date research findings, and to refresh memories. As an example, the Orchard Floor Management Workshop provided in-depth coverage of strategies for managing the ground cover in ways that reduce the need for herbicides while aiding in the control of both vertebrate pests and movement of invertebrate pests such as the 2 spotted mites. All of these meetings involved research staff from the Hudson Valley lab and when available, staff from Geneva and Ithaca:

- Informal IPM field meetings
- Postbloom and preharvest twilight meetings
- Special Integrated Pest Management training sessions
- Annual Commercial Tree Fruit Growers Schools
- Biennial Commercial Small Fruit Growers Schools
- Biennial Commercial Grape Growers Schools
- Commercial Stone Fruit School
- Herbicide Workshop

- Orchard Floor Management Workshop
- Orchard Nutrition Short Course
- Workshop on Safe Use and Storage of Pesticides

Media: Daily radio broadcasts and code-a-phone messages provided growers with valuable up-to-the-minute information regarding weather (as provided by the National Weather Service), insect and disease status, scouting information, pest thresholds, control options, and cultural information. These broadcasts and code-a-phone messages were utilized daily from April through late June , and then weekly through August. The target audience were the commercial fruit growers. However, many hobby farmers and homeowners with several back-yard trees listened regularly. Audience impact was evident from the phone calls received by the commercial fruit agent and also the by home grounds agent.

Newsletters (18-24 per year) updated growers on pest status, thresholds, pest biology, IPM scouting techniques, control measures, cultural information, and research. Although not as timely in many ways as the radio broadcasts, newsletters allowed for more lengthy discussions of various topics including upcoming pests and degree-day thresholds.

An excellent method for introducing IPM has been on-farm visits focusing on a specific grower problem. Discussions and hands-on observations often centered around scouting techniques, thresholds, methods of reducing a pest population while leaving a predator population intact, promoting the buildup of a predator population either through the use of soft pesticides or, when possible, by allowing time for the predator to gain control of the pest population, and cultural practices.

Study Tours: Study tours provide growers with a valuable insight into not only the cultural practices of other regions, but also the IPM practices utilized, successful and otherwise. A valuable exchange of information between growers, researchers and consultants is achieved. Several tours were offered for Hudson Valley growers. In addition, Hudson Valley growers had the opportunity to converse with growers from other regions who came to tour the Hudson Valley:

- West Virginia fruit growers tour of the Hudson Valley. June 1983
- Connecticut fruit growers tour of the Hudson Valley. July 1983
- PA and WV fruit industry tour. June 1984
- NY and NE Apple Institute Annual Meeting tour. July 1984
- International Dwarf Fruit Tree Association Summer Tour to the Hudson Valley. June 1985
- Small fruit growers tour to Massachusetts. July 1985
- Hudson Valley growers to the NYSAES at Geneva. August 1986
- Pennsylvania fruit growers tour the Hudson Valley. June 1987
- Small fruit growers tour to Connecticut. August 1987

Research: Field trials were set up in several locations to evaluate the effectiveness of Ridomil in preventing and/or eliminating Phytophthora and to evaluate its effect on tree growth. This study was conducted on newly planted trees in heavy soils, young trees in clay, and young trees in loamy soil. This project was conducted in cooperation with Ciba Geigy and Dr. Dave Rosenberger.

Columbia County Extension Programs 1974-1979 — David Ophardt

1975: An early morning radio program with a weather report and pesticide recommendations complemented recommendations for pest control and cultural practices provided during farm visits. Radio programs and farm visits were continued every year.

1976: In cooperation with the Hudson Valley Lab, a full program of pest management was initiated with pest and weather monitoring. The program provided information concerning pest populations which enabled fruit growers to control fruit pests more efficiently. Another program involved learning how to control the spotted tentiform leafminer which had recently become a serious pest in the northeast. With the help of researchers at the Hudson Valley Lab, control measures were devised, but effective implementation required better orchard monitoring by growers.

1977: Educational efforts concerning integrated pest management methods constituted an important part of the program. The annual fruit school provided many reports of new pest control techniques that growers could utilize. This year we participated with the NYSAES in a pest management program which provided more information about pest levels so we could make more meaningful recommendations via newsletters, the daily radio broadcasts, farm visits, office calls, and the newly established code-a-phone system. An educational program was held early in the spring to give detailed information concerning pests, with emphasis on the leafminer, and to make recommendations for its control. This was followed by comments and reports during the remainder of the season. In cooperation with Dr. Rick Weires, research on monitoring and controlling the phosphate-resistant strain of spotted tentiform leafminer continued.

1978: Reports on pest control research were made at the fruit school, and further instruction in use of integrated pest management techniques was given at a special spring meeting. In 1978 we again cooperated in the integrated pest management program. An assistant monitored certain orchards to provide more information on pest problems for newsletters and radio programs. Apple maggot monitoring boards were used by several growers to monitor for this important pest. Some growers were able to reduce their pesticide applications where maggot pressure was low. Timely control recommendations made during the radio programs helped growers achieve excellent control of spotted tentiform leafminer. A major tour to a fruit growing area in Pennsylvania and two other tours to Massachusetts and Western NY were sponsored to show growers some IPM and cultural practices that are being adopted in other areas.

1979: A demonstration apple maggot monitoring program was conducted. The monitoring procedure was taught to 15 growers who had expressed interest. Some of these growers found they could safely eliminate several sprays by waiting until apple maggot moved into the orchard. A tour to the Northwest was sponsored to give growers the opportunity to see fruit production, handling techniques, and pest control techniques in the largest apple producing state in the country.

Ulster County Extension Programs 1970-1991— Warren Smith

Chronology and Impact of Ulster/Orange County Fruit Grower Radio Reports, 1970-1993

1970	WGHQ-Kingston. Impact audience 300 fruit growers/pesticide applicators.
1975	WGHQ-Kingston; WHVW-Hyde Park, and WALL-Middletown. Impact audience 450 fruit growers/pesticide applicators.
1983	WGHQ-Kingston, WHVW-Hyde Park, and WTBQ-Warwick. Impact audience 450 fruit growers/pesticide applicators.
1986	WGHQ-Kingston, WEOK-Poughkeepsie, and WTBQ-Warwick. Impact audience 400 fruit growers/pesticide applicators.
1990	WGHQ-Kingston and WRWD-Highland. Impact audience 375 fruit growers/pesticide applicators.
1990	WRWD-Highland. Impact audience 375 fruit growers/pesticide applicators.
Present	WRWD-Highland. Impact audience 350 fruit growers/pesticide applicators.

Chronology of Extension Education Programs Relating to IPM 1986 - 1992

February 4-5, 1986	Hudson Valley Fruit School
March 26, 1986	Pre-Season IPM Workshop
April 23, 1986	Prebloom IPM Strategy Meeting
	Held two sessions: one for agribusiness, one for growers
May 28, 1986	Postbloom IPM Strategy Meeting
June 25, 1986	IPM Strategy Meeting
February 3-4, 1987	Hudson Valley Fruit School
March 9, 13, 1987	Hudson Valley "Do-It-Yourself" IPM Program
April 20, 1987	Prebloom IPM Strategy Meeting
May 18, 1987	Postbloom IPM Strategy Workshop
June 3, 1987	IPM Field Meeting
July 1, 1987	IPM Field Meeting
February 2-3, 1988	Hudson Valley Fruit School
February 25, 1988	Hudson Valley Small Fruit School
March 9, 1988	Hudson Valley Stone Fruit Meeting
May 23, 1988	Postbloom Twilight Meeting
May 24, 1988	Sprayer Calibration Workshop
June 22, 1988	Hudson Valley Field Day for Growers
February 7- 8, 1989	Hudson Valley Fruit School
March 7, 1989	Hudson Valley IPM Workshop
April 4, 1989	Small Fruit Program
May 2, 1989	Prebloom IPM Meeting
May 24, 1989	Postbloom Twilight Meeting
June 15, l989	IPM Workshop - Field
August 9, 1989	IPM Workshop - Field
February 6-7, 1990	Hudson Valley Fruit School
March 5, 1990	IPM In-depth Workshop
April 11, 1990	IPM - Prebloom Strategies
May 14, 1990	Postbloom Twilight Meeting
June 4, 1990	IPM Strategy Workshop
February 5-6, 1991	Hudson Valley Fruit School
February 26, 1991	Sprayer Calibration Workshop
April 16, 1991	IPM Prebloom Meeting
May 9, 1991	Postbloom Twilight Meeting
May 15, 1991	Special-Pear Pyslla Control Workshop
June 18, 1991	Sprayer Calibration Workshop
June 24, 1991	IPM Strategy Workshop
February 4-5, 1992	Hudson Valley Fruit School
March 6, 1992	IPM—Preserving Agric. Chemicals
April 8, 1992	Special Use-Pear Pyslla Control
May 5-6, 1992	Hudson Valley Prebloom Workshop
May 27-28, 1992	Hudson Valley Postbloom Twilight Meeting
January 19-20, 1993	Hudson Valley Small Fruit Meeting
February 2-3, 1993	Hudson Valley Fruit School

March 2, 1993	Hudson Valley Pear Production Meeting
March 15, 1993	Apple Varieties and Rootstocks for Commercial Growers

The Hudson Valley Tree Fruit Farm Advisor Program 1986-88: The goals of the extension-sponsored farm advisor program were to determine the economic feasibility of an IPM scouting program and to demonstrate to growers the benefits of hiring or contracting with an IPM practitioner. In 1988, grower enrollment in the program reached full capacity and provided funding for a full-time farm advisor employed by Cooperative Extension. In 1989, the scouting program was fully privatized when the farm advisor for the 1987 and 1988 seasons became a private consultant. As reported in the January 1989 *Reports from IPM Research, Development and Implementation Fruit Projects*, "The goals have been met over the course of the three year program." In 1992 the same person still provided limited IPM consulting, and several other persons joined the ranks of IPM consultants in the area.

Introduction of a Simplified Insect Management program in the Lower Hudson Valley: In 1989 a simplified apple insect management program (SIMP) was introduced to five commercial growers. Warren Smith, Ulster County Extension Agent, Joe Kovach, IPM Support Group, NYSAES, and Art Agnello, Dept. of Entomology, NYSAES, Geneva, NY delivered this program.

The SIMP program was continued in 1990 by Sal Acampora, a fruit consultant trained to use the SIMP program. Acampora developed the program with several growers. Acampora also set-up comparison study orchards (IPM vs. traditional) which were monitored by the group and used to help deliver the SIMP program. The goals of the program were to: 1) teach the grower and consultant to monitor pest thresholds according to the SIMP manual and 2) as a result, minimize dependency on pesticides without decreasing fruit quality. In 1991 a follow-up survey of grower cooperators measured the degree of grower acceptance and usage in subsequent years.

Entomology 1974-1989 — Richard Weires: The work of Weires is well-documented in the publications cited at the end of this report. The significance of Weires publications, however, may be evident only to those involved in arthropod management. Many of Weires publications contributed to the development of pest thresholds later used by VanKirk and others in the development of scouting programs in eastern NY orchards. Weires published extensively on management thresholds and controls for leafminer (**2, 18, 25, 48, 55, 57**), mites (**4, 11, 12, 52, 58, 62-67**), apple maggot (**13, 17, 19, 20**), dogwood borer (**23, 50**), San Jose scale (**22**), mealybug (**49**), periodical cicada (**53**), tarnished plant bug (**61**) and other miscellaneous fruit pests. He experimented with integrated mite control strategies and reduced pesticide strategies long before these areas of investigation became fashionable (**58, 59**). Weires cooperated with many different scientists in his research. The list of 59 different coauthors included in his publications is a virtual "Who's Who" of tree fruit research in the northeast. Weires' research was well received by commercial growers as evidenced by the many invitations he received to present his work at horticultural meetings (**231-256**).

Weires also conducted an extensive pesticide evaluation program (**126-152**). Results of his pesticide evaluations have been used throughout the northeast to formulate pest management strategies for fruit insects and mites. Because of his ability to manage field pesticide trials, Weires was able to generate $35,000 to $50,000 per year in grants from agrichemical companies. He contributed generously from these funds for improvements that benefited all of the scientists at the Hudson Valley Lab. He also used these funds to subsidize most of the IPM-related research that he conducted.

Plant Pathology 1978-1991 — Dave Rosenberger: IPM-related activities are listed by the year they in which the projects were completed or terminated. Some projects originated 15 or more years ago and are still active are reported only in the section above under active projects. Relevant publications which resulted from the research are listed after each project description.

1992 — Incidence of tomato ringspot virus in fruit plantings in eastern NY and impacts on productivity of infected apple trees: The incidence and impact of TmRSV in apples, peaches and plums has been investigated. Affects of TmRSV on yield of infected apple trees was documented. Experiments were conducted to determine if nematode vectors could be controlled with nematicides. As a result of these experiments, we have recommended that Hudson Valley fruit growers use non-chemical means to avoid TmRSV-induced losses in fruit plantings. **(34, 36, 38, 39, 154, 174, 213, 223).** [1980-1992; Final research publications are being compiled].

1991 — Control strategies for Fabraea leafspot on Bosc pear: Fungicides were evaluated to determine the most effective fungicide strategies for controlling this disease. Work in the early 1980's provided information on spore discharge periods and wetting periods required for infection. **(26, 89).** [1979-80, 1991; program funds].

1990 — Designing minimal fungicide strategies for controlling summer diseases in southeastern NY: The NY State IPM program provided three years of funding to determine IPM strategies for summer diseases in the Hudson Valley. Initial studies were conducted in cooperation with Jim VanKirk. We showed that the number of summer fungicide applications could be reduced by roughly 50% if benomyl and/or mancozeb were used at appropriate rates. These fungicides provided extended protection against infection, and benomyl was shown to have some eradicant activity as well. The value of control strategies resulting from these studies was reduced when the mancozeb label was withdrawn and benomyl residues in fruit became suspect after the Alar Scare. However, summer disease-control programs based on benomyl are still widely used throughout the northeast. **(185, 101, 108, 118, 218, 219).** [Field research conducted 1986-1989; funded by NY State IPM Program].

1989 — Analysis of Variation in the Preparation and Interpretation of Pseudothecial Squash Mounts of *Venturia inaequalis:* Apple growers throughout the northeast use apple scab ascospore maturity counts to help them time apple scab sprays. Although these counts have been used for more than 40 years, this was the first statistical analysis of their reliability. Results of the study showed that considerable variability exists between observers. Furthermore, there is a previously unreported delay between what observers reported as morphological maturity and the time that spores were mature enough to discharge. Seasoned observers (as in the Hudson Valley) provided consistent maturity counts and had already incorporated adjustments into early-season spray recommendations to account for the delay between morphological maturity and actual spore discharge. As a result of this study, however, we found we were able to reduce by 50% the number of individual pseudothecia which needed to be counted to provide an accurate estimate of ascospore maturity. **(7, 9).** [Research funded in 1989 by the Northeast Regional IPM Project, NE-156].

1988 — Strategies for delaying early scab sprays based on inoculum dose: In this cooperative project with Bill MacHardy and Dave Gadoury from University of New Hampshire, we evaluated the impact of eliminating early-season fungicide sprays in apple orchards that had very low levels of apple scab the preceding season. Effective control of apple scab was achieved in most test orchards, even when the first fungicide was delayed until as late as the pink bud stage. Results from these trials were published in Fungicide and Nematicide Tests **(85, 88)**. The Hudson Valley experiments provided the basis for further research by Wilcox et al., and their research lead to

development of the four-spray SI scab control program which is now considered standard NY IPM strategy. Although the concept of eliminating early scab sprays was first tested in New Hampshire and the Hudson Valley, the four-spray SI fungicide program for apple scab has not been promoted in the Hudson Valley because of concerns about reliability of the program. In our field trials between 1986 and 1988, we found that the delayed spray program occasionally failed and resulted in 4-8% fruit scab. (We now suspect that the scab control failures occurred where apple scab conidia over wintered in buds.) The extended spray interval during bloom in the four-spray SI program could occasionally result in significant levels of quince rust infections on fruit in the Hudson Valley. We need more information on the frequency of apple scab conidia surviving in buds and on the effectiveness of SI fungicides for quince rust before the four-spray SI strategy can be recommended in the Hudson Valley. **(8, 13a).** [Research funded in 1986-1988 by the Northeast Regional IPM Project, NE-156].

1983 — Control of black knot on plums: Field fungicide trials were conducted to determine the best strategies for controlling black knot. Results of experiments were incorporated into state-wide recommendations for disease control. **(29, 72, 87).** [Field trials conducted 1979-83; supported by agrichemical companies and The Northeast Pesticide Impact Assessment Program].

1981 — Epidemiology and control of twig blight caused by *Nectria cinnabarina:* Neither fungicide applications nor detailed pruning proved effective for controlling Nectria twig blight in Rome orchards in the Hudson Valley **(35)**. [Funded by western NY apple growers and processors].

IPM RELATED PUBLICATIONS RESULTING FROM RESEARCH AND EXTENSION PROGRAMS IN EASTERN NEW YORK

The following list of publications relating to fruit IPM in eastern New York includes most of the publications authored by Rick Weires, Dick Straub, Dave Rosenberger, and their co-workers over the past 15 years. The publications are divided into three broad categories:

1. Journal articles, book chapters, and technical publications (references 1-67): These publications represent the scientists contributions to the scientific literature.
2. Technical publications on pesticide efficacy (references 68-152): These short reports document field trials. Results of the trials are used to formulate pesticide recommendations provided to growers and agrichemical companies.
3. Extension publications (references 153-257): IPM fact sheets, proceedings of state horticultural societies and state IPM meetings, articles published in the popular press, station publications which provide applied information to growers, and extension information sheets ('unpublished hand-outs') distributed at county fruit schools are all included in this list.

Within each category, publications are listed alphabetically by senior author.

Journal Articles, Book Chapters, and Technical Publications

1. Agnello, A. M., Spangler, S. M., Reissig, W. H., Lawson, D. S., and Weires, R. W. 1992. Seasonal development and management strategies for Comstock mealybug in New York pear orchards. J. Econ. Entomol. 85:212-225.
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