1993 KENTUCKY APPLE IPM SCOUTING PROGRAM REPORT

TITLE: Application of Pest Predictive Technology for Widely Scattered Apple Orchards

PROJECT LEADERS: Ric Bessin, Extension Entomologist
Jerry Brown, Extension Horticulturist
John Hartman, Extension Plant Pathologist
Doug Johnson, Extension Entomologist
Terry Jones, Extension Horticulturist
John Strang, Extension Horticulturist

TECHNICIAN: Christopher Smigell

OBJECTIVE: To determine and demonstrate the effectiveness of Integrated Pest Management (IPM) technology for commercial apple growers in widely scattered locations. Effects measured include:

> Pesticide reduction potential
> Fruit quality
> Cost - effectiveness
> Grower acceptance

INTRODUCTION:

The 1993 Apple IPM Program was funded mainly by USDA/ES/IPM funds allocated to Kentucky and in part by funds carried over from a previous USDA/ES/IPM grant; professional support was provided by the University of Kentucky Cooperative Extension Service. The purpose was to demonstrate to Kentucky apple growers the application of Integrated Pest Management practices in the management of their orchards. IPM relies on orchard management practices such as pest and tree monitoring and locally collected weather data to predict the activities of certain insects and diseases.

Using IPM, the grower applies pest management procedures as needed based on orchard monitoring and predictive models rather than according to a calendar schedule. In addition to saving money, reduced sprays result in decreased potential applicator exposure to pesticides, pest resistance development, pesticide residues on food, harm to bees, water contamination, soil compaction, and drift to other crops. Where IPM calls for more sprays, increased crop quality should occur.

EXECUTIVE SUMMARY:

The 1993 Apple IPM Program, funded in part by USDA/ES/IPM, involved Kentucky apple growers in the application of Integrated Pest Management practices in the management of their orchards.

There were three major changes in the program from 1992 to 1993. 1) Growers scouted their own orchards, rather than using U.K.-employed scouts. 2) U.K. specialists were available each Monday morning to growers who wished to call and ask for technical advice. 3) A part-time IPM technician accumulated and analyzed apple IPM data submitted by the growers. This served to better educate them about the presence and progress of various diseases and pests, so they could make more educated management decisions.

Daily weather and monitoring data from orchard weather stations were recorded on scouting forms by the growers and delivered weekly to the technician at the Lexington campus either by phone or by fax. The weather data were used to predict fire blight infection periods, and to calculate degree days for insect management. Pheromone traps for codling moth and San Jose scale placed in the orchards were examined weekly to monitor these insects. Several growers maintained and analyzed their own orchard data.

Four IPM orchard meetings for growers provided an opportunity for the specialists to address current apple IPM issues and for the growers to discuss concerns in an informal setting. Each of these meetings included a hands-on exercise in which the growers divided into small groups and scouted orchards. This approach was new for 1993, and was very productive. Growers practiced orchard monitoring while having UK specialists available for questions. Kentucky Apple IPM Manuals were distributed to growers for use in scouting and implementing IPM in their orchards. Attendance at the apple IPM field days was good.

Evaluations of IPM versus standard (STD) blocks were made at the end of the season to determine disease and insect damage to the leaves and fruit. There were few significant differences in foliar and fruit pest and disease levels in IPM versus standard blocks. Foliar disease, insect, and mite levels were generally lower in IPM blocks. In addition, IPM did not significantly affect quality of the fruit based on disease, insect, and physiological defects evaluated.

Overall, IPM use generated notable savings among the orchards. Growers with comparison blocks saved an average of $71 per acre using IPM. Individual case studies of each orchard are presented to show how each orchard fared using IPM.

MATERIALS & METHODS

A weather station consisting of at least a minimum/maximum thermometer and a rain gauge, was set up in each orchard as was done in the 1992 program. Three growers used automated weather monitors, a Predictor (Reuter-Stokes, Inc., Cleveland Ohio), an Envirocaster (Neogen Inc., Lansing Mich.), and a

METOS Disease Predictor (Pest Mgt. Supply Inc., Amherst, Mass.). The Envirocaster was purchased in 1991 with funds from a University of Kentucky program enhancement grant, and the METOS and Predictor were purchased by the growers. Weekly scouting data and daily weather data were recorded on scouting forms by the growers and collected weekly by the technician, in the manner described above. Growers also placed pheromone traps for codling moth and San Jose scale in the orchards and checked them weekly to help monitor these insects.

The data were used in several ways. Apple scab infection periods were determined when the weather data, including leaf wetness information were applied to Mill's Table. Growers quickly reacted to infection periods with eradicative fungicides to prevent symptom development. Fire blight prediction was accomplished when data were entered into the MARYBLYT predictive computer program. Last year two growers used the MARYBLYT program on their own personal computers; this year that number increased to seven. Data for the rest were entered on a MARYBLYT program installed in a University of Kentucky computer. Fire blight infection data were combined with weather forecasts to determine whether or not and when to spray. Insect management also relied on the weather data to calculate degree days and was used in conjunction with the scouting data to determine when certain insect pests would be active. Pheromone trap catches and degree day accumulations were used to predict the time of codling moth egg hatch and San Jose Scale crawler movement for optimum timing of insecticide applications. Insecticides were targeted at 3% egg hatch for codling moth.

Each orchard in the 1993 program was scouted weekly throughout the main growing season (March 29 - July 8). To scout, the grower would check a random sample of 5 trees for leaf and fruit damage and record any findings on the scouting log in both the IPM and standard blocks. Records of grower spray and other pest management activity were collected along with the weather and scouting data.

There were four IPM field day meetings for growers held at various orchards in the program periodically during the season. These informal meetings provided an opportunity for the specialists to address current apple IPM issues and for the growers to discuss problems of concern to them in an informal setting. Some of the meeting topics discussed were sprayer calibration, insect identification, San Jose scale and Japanese beetle management, thinning procedures, fire blight control, summer disease management, and pest problems anticipated before the next meeting. Growers were taught to look for the same insect and disease signs and symptoms that the scouts had looked for in the previous two years.

Participant Grouping

Each grower completed an orchard history form early in the season that described their principal orchard problems. All growers were to establish an IPM block in which insects were controlled only when warranted as opposed to the standard or conventional spray schedule. However, for disease control, orchard history information was used to define a specific disease control program. Although summer disease control would not differ between blocks, diseases in the IPM block would be controlled early in the growing season in one of the following three ways as compared to the standard treatment:

I. A standard fungicide spray program if significant apple scab was present the previous year. This was to be a "clean up" program making use of both protective and eradicant fungicides so that fungicide use could be reduced in future years - 3 growers.

II. A "4-spray" reduced fungicide system relying on early applications of the fungicide Nova at critical times for orchards having no significant apple scab the previous year, but having annual cedar-apple rust problems - 10 growers

III. A disease predictive reduced fungicide program if there was no significant apple scab or cedar-apple rust the previous year - 3 growers.

Evaluations were made at the end of the season to determine disease and insect damage on the leaves and fruit. All year-end evaluating was done by C. Smigell, except at UKREC (D. Wolfe). Both the IPM and standard blocks were tested separately so that a comparison could be made.

Evaluation Procedures:

Foliar analysis - Five trees per block were scouted. Trees were chosen over a wide range of the block, and at varying altitudes, when possible. 100 leaves per tree were examined (ten leaves on ten different branches).

Fruit analysis - 100 fruit were examined per block. Fruit were examined over a wide range of the block, and at varying altitudes, when possible. Sampling per tree varied from five to approximately fifteen fruit. This year's eval- uations were done about a week before harvest, so fruit were examined on the tree, and not removed. The modified Russo-Rajotte apple grading scheme was used for the rating. The following categories contain the defects that were included in the evaluation:

I. General Class Defects: scald, hail.

II. Physiological Defects: russetting, fruit spot (mainly cork spot).

III. Insect Defects: codling moth (calyx tunneling and stings), plum curculio scars, San Jose scale, European red mite foliar damage, plant bug stings, miscellaneous insect fruit/foliar feeding.

IV. Disease Defects: cedar-apple rust, apple scab, sooty blotch, flyspeck, powdery mildew, rots (bitter, black, white).

Owing to time constraints, not all participating orchards were visited and evaluated at the end of the season. Priority was given to those farms containing IPM and standard comparison blocks. Twelve orchards ended up being scouted. The orchards were grouped into the following categories for easier analysis:

I. Growers with IPM and standard comparison blocks - 6 growers.

II. Growers with orchards entirely on an IPM spray schedule - 6 growers.

RESULTS AND DISCUSSION

Attendance at the apple IPM workshops was good. Growers and Extension Agents not actually in the scouting program participated in these meetings in addition to the 18 growers previously identified. Kentucky Apple IPM Manuals were distributed for a reference; updates were produced and distributed during the season as needed. Growers used the manuals to scout and implement IPM in their orchards. The other meetings were held at three critical times during the season at orchards of participants and attendance averaged 25 people. Growers were taught to look for the same orchard details that the scouts had learned.

There were no significant differences in foliar and fruit pest/disease levels in IPM versus STD blocks. Foliar disease levels were generally less in IPM blocks (Table 1., Figure 1.). Foliar insect damage was roughly equal in both plots (Table 1., Figure 2.). In addition, European red mite damage was less in IPM blocks (Table 1, Figure 3). IPM did not significantly alter fruit quality based on disease, insect, and physiological defects evaluated (See Table 1 and Figures 4, 5, 6.). Plum curculio damage and San Jose scale were generally reduced in IPM. Table 2., showing data from 1992 is also included for comparison.

Table 1. Comparison of apple foliage and fruit defects between IPM and standard blocks - 1993

	IPM	STD	Difference[1]
I Foliage Analysis[2]			
A. Diseases			
Cedar Apple Rust	1.0%	1.2%	no
Frogeye Leaf Spot	15.3	17.7	no
Fire blight (strikes)	0.3	0.7	no
Powdery Mildew	5.4	3.6	no
Scab	0.1	0.2	no
B. Insects and Mites			
European Red Mite			
(1) no damage	14.3%	13.0%	no
(2) 1st evidence	24.8	8.5	no
(3) stippling & silvering	41.3	33.0	no
(4) bronzing	19.3	45.5	no
Green Apple Aphid	0.0	0.0	no
Japanese Beetle	12.2	12.0	no
Rosy Apple Aphid	0.0	0.0	no
Misc. Leaf Scars	6.0	7.5	no

II Fruit Grading[3]

A. Diseases[4]			
Scab	0.0	0.0	no
Sooty Blotch	23.4	27.0	no
Flyspeck	43.2	23.0	no
Rots (various fungal agents)	0.0	0.0	no
B. Insects			
Codling Moth (stings)	1.4	1.4	no
Plum Curculio (scars)	3.6	6.2	no
San Jose Scale	5.4	9.4	no
Misc. Feeding Scars	1.8	0.6	no
C. Physiological Defects			
Cracks	0.0	0.0	no
Fruit Spot (mostly cork spot)	21.2	35.0	no
Russetting	4.4	8.4	no
Scalding	7.2	11.0	no

[1] Statistically significant (P=0.05) using a matched-pair t test

[2] Per orchard, 5 trees per block and 100 leaves per tree were analyzed for defects; 5 growers were included in this study except Red Mites (4 growers). Numbers represent percent leaves or shoots affected.

[3] Per orchard, 100 fruit per block (200 per orchard) were graded; 5 growers were included in this study.

[4] Numbers represent disease index - percent symptomatic fruit of 100 sampled X average rating (0 = badly damaged; 10 = no defect)

Table 2. Comparison of apple foliage and fruit defects between IPM and standard blocks - 1992

		IPM	STD	Significant Difference[1]
I	Foliar Analysis			
A.	Diseases			
	Cedar Apple Rust	3.2%	5.2%	no
	Frogeye Leaf Spot	5.7	7.3	yes
	Fire blight (strikes)	5.2	3.0	no
	Powdery Mildew	0.0	0.0	no
	Scab	1.9	2.3	no
B.	Insects and Mites			
	European Red Mite			
	(1) no damage	45.0%	39.8%	yes
	(2) 1st evidence	30.3	22.4	yes
	(3) stippling & silvering	19.3	25.3	no
	(4) bronzing	5.4	12.4	no
	Green Apple Aphid	3.2	2.8	no
	Japanese Beetle	6.2	7.1	no
	Rosy Apple Aphid	2.0	2.5	no
	Misc. Leaf Scars	2.1	2.0	no
II	Fruit Grading[3]			
A.	Diseases			
	Scab	1.1[4]	2.3	no
	Sooty Blotch	0.6	0.6	no
	Flyspeck	5.8	6.8	no
	Rots (various fungal agents)	0.98	0.2	no
B.	Insects			
	Codling Moth (stings)	0.02	0.04	no
	Plum Curculio (scars)	0.04	-	-
	San Jose Scale	0.19	0.16	no
	Misc. Feeding Scars			
C.	Physiological Defects			
	Cracks	0.0	0.0	no
	Fruit Spot (mostly cork spot)	6.7	6.7	no
	Russetting	0.12	0.11	no

[1] Statistically significant (P=0.05) using a matched-pair t test

[2] Per orchard, 5 trees per block and 100 leaves per tree were analyzed for defects; 5 growers were included in this study except Red Mites (4 growers). Numbers represent percent leaves or shoots affected.

[3] Per orchard, 100 fruit per block (200 per orchard) were graded; 5 growers were included in this study.

[4] Numbers represent percent symptomatic fruit of 100 sampled.

Overall, IPM use generated notable savings among the orchards. The number of pesticide applications and trips through the orchard were reduced in IPM vs. STD blocks (Figure 7). While the number of fungicide and insecticide sprays saved in the IPM versus the STD blocks was nearly the same this year and last, overall monetary savings were greater this year than last. On the average, growers used one less fungicide spray on the IPM block, saving an average of $17 per acre, compared with $1 per acre in 1992. Reducing insecticide use from 10 to 8 applications saved an average of $21 per acre for IPM blocks, compared with $38 in 1992. When insecticide, fungicide, and spray application costs ($25 per acre for each trip through an orchard) are calculated, growers with comparison blocks saved an average of $71 per acre using IPM, compared with $56 in 1992 (Figure 8). Per acre spray costs for apple growers are typically divided between application costs ($425) and chemical costs ($425). One grower saved as much as $230 per acre overall by using IPM. However, another spent an extra $8 per acre (Figure 9). These figures reflect differences in levels of grower expertise and in perceived pest problems. In some locales, growers following good IPM practices in fact had to spray more than growers in other locales because of more disease favorable weather. As growers become more comfortable using IPM, savings could increase. Numbers of sprays applied to IPM blocks decreased from 1992 to 1993, (Figure 10) possibly due to introduction of MARYBLYT in 1993. On the other hand, some growers, observing the success of IPM, began to adopt IPM practices and reduce pesticide use in their standard blocks, thus masking some of the real differences between IPM and standard programs.

Most growers followed through on their weather and orchard management records and took appropriate actions when needed. Growers were taught how to manage their orchard using IPM, one of the program objectives. The results of the IPM costs and benefits for each orchard were also helpful in showing IPM benefits and gaining grower acceptance and understanding. The MARYBLYT computer printouts of fire blight infection and progress impressed the growers since the information almost exactly matched what the growers were observing in their own orchards.

In December, 1993, the results from the 1993 Apple IPM Program were presented to the Kentucky State Horticulture Society. The results were well received and it is likely that new growers will use IPM in 1994. Additionally, most of the present participants want to continue to learn more and refine the IPM implementation in their orchards.

CASE STUDIES *Data Removed.*