4-1992

Pesticide Use on Apples Grown in Connecticut: 1990

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93-26
April 1992

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Acknowledgment

This publication was prepared by the Cooperative Extension System of the University of Connecticut College of Agriculture and Natural Resources. Presented are the results of a survey that was funded by a grant from the Extension Service, United States Department of Agriculture Special Project funds for the National Agricultural Pesticide Impact Assesment Program.

Special thanks goes to David A. Kollas of the Department of Plant Science for his critical review of the questionnaire during its development. The questionnaire was desktop published by Ethel Murdoch of the Agricultural Publications Department and the tables were typed by Sandra Cooper of the West Hartford Cooperative Extension Center. The advice of Thomas W. Feurer, Lorraine M. Los, Norman L. Gauthier and William Coli during this project was helpful.

Special thanks also go to all of the apple growers and the pesticide dealers of Connecticut who devoted time and effort to make this survey a success.

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Introduction

Establishing a database of pesticide use by crop is necessary to respond to issues concerning groundwater, protection of endangered species and pesticide residues on food. There is also a need for state level pesticide use data to respond to benefits assessments of pesticides in the EPA special review process.

The objective of this project was to collect information on the kinds and amounts of pesticides used to control apple pests on 75% of the apple bearing acres in Connecticut during 1990. Growers' opinions on quality, yields and cost of alternative pest control measures were also collected for comparative purposes.

Materials and Methods

A written survey was determined to be the most cost effective and least time consuming method of data collection. Several state organizations and individuals were contacted for ideas on data collection and survey design. The most useful information on collecting alternative pest control methods was found in Tom Feurer's sweet corn survey, designed for the Delaware Agricultural Statistics Service (Feurer, 1990). For pesticide application information, the survey designed by Steve Wood for the New England Fruit Growers' Association, Committee on the Environment was useful (Wood, 1989). Dave Kollas, Pomologist at the University of Connecticut, was also very helpful in designing the survey. (Appendix 1).

The *1989 Connecticut Tree Fruit Survey* (USDA, 1991) states that there are 93 apple growers and 2,633 acres of bearing apple trees in Connecticut. Names and addresses of orchardists were obtained from, *Connecticut Apples: A Guide* (Connecticut Department of Agriculture, 1990), and *Histories of Connecticut Orchards* (Brusic and Brusic, 1990). Names and addresses of certified private applicators in the orchard category were obtained from the Connecticut Department of Environmental Protection, Pesticide Management Division and used as a cross reference.

The survey was designed to collect the following information:

A. Acres planted and average yield
B. Chemicals used for control of each pest
    1. Number of treatments and rates
    2. Cost of chemicals per acre
    3. Method of applications
    4. Time of applications
C. Alternative control methods
D. Potential yield changes from alternatives.

The survey form was divided into the following three sections:

Section A: General Instructions. Each grower was asked to choose one block which was representative of his/her orchard and report all pesticide use during 1990 for that block. Requesting information about a representative block versus the entire orchard reduced the amount of time it took to fill out the survey and encouraged participation. Growers were asked to report every application of every pesticide, the actual area treated, the label rate and the amount of formulation applied including unit of measurement. They were further instructed to fill out the form as completely as possible even if there were questions they could not answer.

Section B: 1990 Regular Spray Program Information. The first part of this section asked for specific information about the orchard

and the representative block. This included the number of acres in the sample block and the entire orchard that was sprayed, number of bushels harvested per acre, number of bushels not harvested per acre and the average gross income per harvested bushel. In the second part, a table format was used to collect pesticide application data for the block. Information requested included date of application and growth stage, trade name and formulation, label rate, actual rate per 100 gallons, gallons of mix per acre, acres treated, application technique and pests targeted. Block spray record information was used to extrapolate chemical use data for the entire orchard.

Section C: Alternative Program Information. A table format was used to collect information and opinions on alternative pesticides and/or methods which could be used in lieu of the pesticide reported in Section B. The expected change in quality, yield and cost of the alternative was also requested. To indicate what effect an alternative pesticide and/or method would have in comparison to the pesticide they had used, growers checked "no change", "increase", "decrease" or "don't know". If there was an increase or decrease, they were asked "how much?" This information was requested in the form of educated opinions in order to obtain the greatest input from growers.

To encourage growers to return the survey and ensure collection of data for 75% of the acreage of apple bearing trees, several steps were taken. The first step was to use language that was familiar to apple growers on the survey so that the questions were easily understood. The second step was to explain the purpose of the survey and the need for participation at every opportunity. Presentations were made describing the objectives of the survey and encouraging cooperation at two major fruit grower meetings in Connecticut—the Annual Woodstock Fruit Growers Meeting on February 13, 1991 and the Annual Connecticut Pomological Society Meeting on February 20, 1991. A newsletter article explaining the survey and the need for grower participation was printed in the *Fruit Growers Newsletter*, (University of Connecticut CES, March 22, 1991).

On February 26, 1991, the surveys were mailed with a cover letter explaining how data would be used and kept confidential. Follow-up post cards were sent one week later reminding growers that their input was needed. Follow-up phone calls were made three weeks after the surveys were mailed encouraging cooperation and offering assistance in completing the survey over the phone or on the farm. Each grower was called a minimum of three times in an attempt to contact them. Growers with the greatest amount of acreage were all contacted by phone to assure their cooperation in the program.

In addition, post cards were mailed six weeks after the survey to growers who had not returned the survey and could not be reached by phone. The post cards were handwritten and sent first class mail in

order to personalize them and to keep them from looking like "junk mail." Post cards were used instead of letters, assuming growers would be more likely to take the time to read a short post card versus a letter.

Results and Discussion

Regular spray program

Forty-two surveys (45.2%) were returned out of the 93 mailed. These surveys represented 1,750 acres (66.5%) of the 2,633 acres of apple bearing trees in Connecticut (USDA, 1991). Eleven (11.8%) of the 93 growers went out of business in 1990. This was based on growers who said they were no longer in business or on surveys returned and marked "Moved, No Forwarding Address". The amount of acreage this represents is unknown. Forty growers (43%) did not respond.

Thirty-five of the 42 surveys returned, contained complete and usable pesticide information on 297 acres. These 297 acres were selected by the growers as representative of 1,686 acres. Therefore, all chemical use data in this report is a projection of use on 1,686 acres (64%) of the 2,633 acres of apple bearing trees in Connecticut (USDA, 1991).

Based on the general information provided about each orchard, the following information was calculated.

- All acreage reported was treated with pesticides.
- Average yield was 281 bushels/acre.
- Average number of bushels/acre not harvested was 16.
- Average gross income/harvested bushel was $9.47.
- Average gross income/acre was $2,662.

Apple growers used 73,250 lbs. of pesticide active ingredient (a.i.) to treat 1,686 acres (Tables 1.a. to 1.e.). These tables show the time frame during which each pesticide was applied, the number of applications applied by pesticide, the rates of active ingredients used per application and per year, and the total pounds of active ingredient per year for each chemical used. Micronutrients are not included in the 73,250 lbs. a.i. applied. Micronutrients used are expressed in amount of formulation applied (Table 1.f.). Of the 73,250 lbs. a.i. used, superior oils accounted for 38,668 lbs. a.i. (52.8%), fungicides for 22,437 lbs. a.i. (30.6%), insecticides for 10,962 lbs. a.i. (15%), herbicides for 728 lbs. a.i. (1%), growth regulators for 351 lbs. a.i. (0.5%) and rodenticides for 104 lbs. a.i. (0.1%). Superior oil figures are not included with other insecticide figures in this report. The superior oil numbers are of such a magnitude that they would skew the insecticide figures if combined.

Growers spent $466,717 on chemicals to treat 1,686 acres. Tables 2.a. to 2.f. show the rate of pesticide applied by formulation per acre and per year, and the formulation cost per acre for both a single application and for the year. Of the $466,717 spent on pesticides, fungicides cost $221,215 (47.4%), insecticides $173,630 (37.2%), superior

oils $41,624 (8.9%), herbicides $11,408 (2.5%), micronutrients $8,090 (1.7%), rodenticides $7,364 (1.6%) and growth regulators $3,386 (0.7%).

Formulation costs for each material were obtained in August 1991 from two agricultural chemical retailers in Connecticut. Prices for 1991 were used because 1990 prices were not available for most of the materials. Prices for Plictran 50W and Kelthane 4F are from 1986, and Phosphamidon are from 1990 because these were the last years they were marketed in the state.

Captan, thiram and benomyl comprised 18,883 lbs. a.i. (84.2%) of the 22,437 lbs. a.i. of fungicide used and accounted for $122,718 (55.5%) of the $221,215 spent on fungicides. All 1,686 acres were treated with one or the other of these three fungicides. These figures show a heavy reliance on a handful of fungicides. This is troubling when one considers that fewer fungicides are available for use than two years ago and that disease resistance develops when the same fungicide is used repeatedly over time. See Tables 1.a. and 2.a.

Diuron and terbacil amounted to 449 lbs. a.i. (61.7%) of the 728 lbs. a.i. of herbicide used. These two materials accounted for $8,055 (70.6%) of the $11,408 spent on herbicides and were used on 104 acres (6.2%) of the 1,686 acres. A total of 207 acres (12.3%) of the 1,686 acres were treated with some type of herbicide. See Tables 1.b. and 2.b.

Three insecticides—azinphosmethyl, propargite and phosmet—comprised 7,938 lbs. a.i. (72.4%) of the 10,962 lbs. a.i. of insecticides used. The cost of these three materials was $107,350 (61.8%) of the $173,630 spent on insecticides. All 1,686 acres were treated with one or the other of these three insecticides. See Tables 1.c. and 2.c.

Superior oils totaled 38,668 lbs. a.i. at a cost of $41,624 and were used on 1,329 acres (78.8%) of the 1,686 acres (Tables 1.c. and 2.c.). Growth regulators totaled 351 lbs. a.i. at a cost of $3,386 and were used on 226 (13.4%) of the 1,686 acres (Tables 1.d. and 2.d.). Rodenticides totaled 104 lbs. a.i. at a cost of $7,364 and were used on 196 (11.6%) of the 1,686 acres (Tables 1.e. and 2.e.). Micronutrients cost $8,090 and were used on 289 (17.1%) of the 1,686 acres (Tables 1.f. and 2.f.). Amounts of micronutrients used are shown in Tables 1.f. and 2.f.

Carbaryl is listed both under insecticides (Tables 1.c. and 2.c.) and growth regulators (Table 1.d. and 2.d.) because of its unique ability to be used as an insecticide and a fruit thinner. The combined figures for carbaryl use are:

- acres treated—197 (11.7%) of the 1,686 acres;
- time of application—petal fall, 8/25/90;
- number of applications (range)—1 to 4;

- average number of applications—1.7;
- rate applied per application (range)—0.4 to 4.0 lbs. a.i./A;
- average rate per application—1.4 lbs. a.i./A;
- average rate per year—1.4 lbs. a.i./A;
- total formulation cost/year—$2,113;
- total amount applied in 1990—364 lbs. a.i.

The total amount of carbaryl used (364 lbs. a.i. on 197 acres) is thought to be low. It is possible that some growers did not consider carbaryl a pesticide when they used it as a thinner and, therefore, did not report its usage. Carbaryl was reported as being used as a thinner on 188 acres (11.2% of 1,686 acres).

Tables 3.a. to 3.c. show which methods of application were used to apply each pesticide. When applying pesticides, the most common method of application for fungicides, insecticides and superior oils was air blast (Table 3.a. and 3.c.). All growth regulators and micronutrients were also applied with air blast sprayers. Herbicides were applied with handguns, boom sprayers and other methods (Table 3.b.). Rodenticides were applied with spreaders or by hand.

Alternative control methods

Tables 4.a. to 4.e. show the opinions of growers on how the use of alternative pesticides and methods would change the quality, yield and cost of their crop. One hundred and eighty-five alternatives were listed for 47 different pesticides or pesticide combinations. Of the 185 alternatives, 160 or 86.5% of them were other pesticides. Twenty-five (13.5%) were nontraditional chemicals or methods (i.e., trapping, mowing, horticultural soap, superior oils, natural predators, disease resistant varieties and scouting). Nineteen growers stated that there were no alternatives for various pesticides listed in Section B.

Of the 185 alternatives suggested, growers felt that only 7.6% would improve the quality of the fruit, 3.2% would improve yields and 15.1% would decrease the costs. Quality, yield and costs were generally seen to be negatively affected by the use of alternatives. Forty percent of the alternatives would cause the quality to decrease, 27.6% would decrease yield and 36.8% would increase the costs. Some of the growers felt that certain alternatives could be substituted without causing any change to their crop. No change in quality was stated for 28.1% of the alternatives, 40% would not cause a change in yield, and 11.3% would not cause a change in cost. As in any survey, there were those who did not have an opinion or did not know what would happen if an alternative was used. Growers did not know how 24.3% of the alternatives would change the quality, how 29.2% would change the yield or how 36.8% would change the cost.

Two conclusions can be drawn from Tables 4.a. to 4.e. One is that apple growers are heavily dependent on chemicals. Of the 185 alternatives listed, only 16 (8.6%) were nonchemical alternatives. As one grower said, "I have been working with the orchards since 1965 and I would have the following observations. First, you cannot possibly grow apples without spraying. Second, the public in this area will not buy any apple which is visually defective." The second conclusion is that there is no consistent opinion among growers as to the effect each different alternative would have on quality, yield or cost.

Pests and Problems

Tables 5.a. to 5.f. show the number of acres treated for and the number of applications made for each type of apple pest. Thirty-three of the 42 surveys returned by growers contained usable information on control of fungi. These surveys accounted for 229 acres selected by growers as representative of 1,219 acres. The three diseases affecting the greatest number of acres were apple scab, apple rusts and summer diseases (i.e., sooty blotch and fly speck). Each of these diseases were treated for on 88% or more of the 1,219 acres. Apple scab, affecting 100% of the 1,219 acres, required an average of 9.1 applications per acre. The disease white rot affected the least number of acres (3.3%) and was treated for an average of 2.0 applications per acre. See Table 5.a.

Thirty-four of the 42 surveys contained usable information on all the other pests and problems (i.e., weeds, insects, thinning, preharvest drop and rodents). These surveys accounted for 239 acres selected by growers as representative of 1,489 acres (Tables 5.b. to 5.f.). Weeds, which consisted of broadleaf and grass types, were treated for on 9.2% of the 1,489 acres for an average of 1.1 treatments per acre. See Table 5.b.

The four insects affecting the greatest number of acres were apple maggot, plum curculio, aphids and leafminers. Each insect was treated for on 89.3% or more of the 1,489 acres. Apple maggots, affecting 100% of the 1,489 acres, required 3.8 applications per acre. See Table 5.c.

One application of growth regulator was used for preharvest drop control on 5.1% of the 1,489 acres. Thinning was done on 17.1% of the 1,489 acres with an average of 1.1 applications per acre. See Table 5.d.

Rodenticides were used for control of orchard mice on 16% of the 1,489 acres, with an average of 1.1 treatments per acre. See Table 5.e.

Micronutrient deficiencies were treated for on 10.8% of the 1,489 acres. An average of 1.3 to 2.7 applications per acre were applied for different deficiencies. See Table 5.f.

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Summary

Growers are dependent on chemicals to grow apples. Records showed 34,582 lbs. a.i., not including micronutrients or superior oils, were used by 35 growers on 1,686 acres in 1990. This represents an average of 20.5 lbs. a.i. of pesticides per acre at a cost of $247 per acre (9.3% of the gross income per acre). The total cost of chemicals used on 1,686 acres of apple bearing trees, including micronutrients and superior oils, was $466,717 or $277 per acre.

In addition to the above numbers, growers' comments constantly revealed their dependency on pesticides. As one grower said, "If I can't get the necessary chemicals, I'll get out of the business."

Using a written survey as the means of collecting information was received well by the growers. Only two growers requested on-site assistance and no surveys were completed over the phone.

A suggestion to improve the next survey would be to mail the survey no later than the beginning of February. Growers do not have time to respond to surveys during the growing season. Another change would be to eliminate the column titled "Label Rate" in Section B. Information in this column was generally either incorrect or a duplication of information in "Your Actual Rate per 100 Gal." column. Label rate information can be determined from pesticide labels by the person compiling the data.

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Table 1.a. Timing, number, and rates of fungicide applications based on active ingredient

Fungicide	Formulation	[a] Acres treated	[b] Time of application	No. of applications (range)	No. of applications (average)	Rate (ai/A) per application (range)	(Rate (ai/A) per application (average)	Rate (ai/A) per year (average)	[c] Total pounds active ingredient /year
benomyl	Benlate 50WP, 50DF	1,285	green tip-9/29	2-15	6.3	.3- 6.0 oz.	2.4 oz.	.9 lb.	1,156
captan	Captan 50WP	1,093	1/2" green-9/29	2-14	7.2	.1- 2.9 lb.	1.2 lb.	8.5 lb.	9,291
	Captan 80WP	364	pink-9/22	1-13	4.5	.1- 2.3 lb.	1.2 lb.	3.4 lb.	1,238
	Captec 4L	44	6/9-9/1	4	4.0	1.0 lb.	1.0 lb.	4.0 lb.	176
	total captan	1,501	1/2" green-9/29	1-14	7.0	.1- 2.9 lb.	1.2 lb.	7.2 lb.	10,808
dodine	Cyprex 65W	569	green tip-6/16	1- 9	3.3	1.1-11.4 oz.	9.1 oz.	1.2 lb.	683
fenarimol	Rubigan EC	1,014	silver tip-6/23	1- 6	4.3	.2- 1.5 oz.	.5 oz.	2.1 oz.	133
ferbam	Ferbam 76WP, Carbamate WDG	160	green tip-6/23	1- 6	3.0	.3- 9.1 lb.	1.7 lb.	3.3 lb.	528
mancozeb	Dithane DF	6	tight cluster-bloom	3	3.0	9.5-22.5 oz.	16.0 oz.	3.0 lb.	18
	Dithane M-45	23	bloom-5/26	3- 4	3.5	12.8-20.5 oz.	14.1 oz.	2.7 lb.	62
	Manzate 200DF	40	tight cluster-6/30	3- 6	4.0	1.1- 2.3 lb.	1.8 lb.	5.0 lb.	200
	Penncozeb 80W	25	1/2" green-6/2	4	4.0	1.6 lb.	1.6 lb.	6.2 lb.	155
	total mancozeb	94	1/2" green-6/30	3- 6	3.7	.6- 2.3 lb.	1.4 lb.	4.6 lb.	432

Table 1.a. Continued

Fungicide	Formulation	[a] Acres treated	[b] Time of application	No. of applications (range)	No. of applications (average)	Rate (ai/A) per application (range)	Rate (ai/A) per application (average)	Rate (ai/A) per year (average)	[c] Total pounds active ingredient /year
mancozeb/ dinocap	Dikar WP	175	5/18-5/26	2	2.0	2.0 lb.	2.0 lb.	2.1 lb.	368
metiram	Polyram 80DF	50	tight cluster-petal fall	3	3.0	2.4 lb.	2.4 lb.	7.2 lb.	360
myclobutanil	Nova 40W	935	1/2" green-7/21	1- 7	3.3	.6- 3.2 oz.	1.6 oz.	3.8 oz.	222
sulfur	Sulfur 83WP	182	6/2-7/21	1- 3	2.5	2.4- 2.5 lb.	2.5 lb.	2.7 lb.	491
thiophanate-methyl	Topsin M 70WP	391	1/2" green-9/1	1-13	5.3	2.3-12.3 oz.	6.0 oz.	13.8 oz.	337
thiram	Thiram 65WP	1,442	green tip-8/18	1-10	3.1	.3- 5.2 lb.	1.9 lb.	4.8 lb.	6,919
total fungicides		-	-	-	-	-	-	-	22,437

Table 1.b. Timing, number, and rates of herbicide applications based on active ingredient

Herbicide	Formulation	Acres treated [a]	Time of application [b]	No. of applications (Range)	No. of applications (average)	Rate (ai/A) per application (range)	Rate (ai/A) per application (average)	Rate (ai/A) per year (average)	Total pounds active ingredient /year [c]
2,4-D	Dacamine 4D	24	5/26-8/4	1	1.0	1.8 lb.	1.8 lb.	1.8 lb.	43
dichlobenil	Casoron 4G	1	4/5, 12/8	1	1.0	4.0- 5.6 lb.	4.5 lb.	4.5 lb.	4
diuron	Karmex DF	101	dormant-12/22	1	1.0	1.6- 7.8 lb.	2.4 lb.	2.4 lb.	241
glyphosate	Roundup	44	5/19-11/10	1- 2	1.5	.8- 4.8 lb.	1.1 lb.	1.1 lb.	48
oryzalin	Surflan A.S.	8	5/28	1	1.0	4.0 lb.	4.0 lb.	4.0 lb.	32
paraquat	Gramaxone Super	110	pink-8/4	1	1.0	4.5-12.0 oz.	8.1 oz.	8.1 oz.	56
simazine	Princep 80W	3	dormant-petal fall	1	1.0	2.0 lb.	2.0 lb.	2.0 lb.	6
	Princep 90 Caliber, Simazine 90G	51	pink-6/16	1	1.0	1.8 lb.	1.8 lb.	1.8 lb.	91
	total simazine	54	dormant-6/16	1	1.0	1.8- 2.0 lb.	1.8 lb.	1.8 lb.	96
terbacil	Sinbar 80WP	83	dormant-12/12	1	1.0	.8- 3.6 lb.	2.5 lb.	2.5 lb.	208
total herbicides		-	-	-	-	-	-	-	728

Table 1.c. Timing, number, and rates of insecticide applications based on active ingredient

Insecticide	Formulation	[a] Acres treated	[b] Time of application	No. of applications (range)	No. of applications (average)	Rate (ai/A) per application (range)	Rate (ai/A) per application (average)	Rate (ai/A) per year (average)	[c] Total pounds active ingredient /year
azinphos-methyl	Azinphos-methyl 35WP, Guthion 35WP	448	tight cluster-9/1	1-10	5.1	.1- 1.9 lb.	.6 lb.	2.8 lb.	1,253
	Azinphos-methyl 50WP, Guthion 50WP	1,141	tight cluster-9/1	1-14	6.3	.1- .9 lb.	.6 lb.	3.4 lb.	3,879
	total azinphosmethyl	1,589	tight cluster-9/1	1-14	6.0	.1- 1.9 lb.	.6 lb.	3.2 lb.	5,083
carbaryl	Sevin 4F	52	6/30	1	1.0	5.6 oz.	5.6 oz.	5.7 oz.	19
chlorpyrifos	Lorsban 4E	317	silver tip-pink	1	1.0	.5- 1.3 lb.	.7 lb.	.7 lb.	222
	Lorsban 50W	354	tight cluster-7/28	1- 4	1.6	.2- 1.2 lb.	.6 lb.	.9 lb.	319
	total chlorpyrifos	671	silver tip-7/28	1- 3	1.7	.2- 1.3 lb.	.6 lb.	.8 lb.	537
cyhexatin	Plictran 50W	25	8/11-8/25	2	2.0	.5 lb.	.5 lb.	1.0 lb.	25
dicofol	Kelthane 35WP	43	7/21-8/25	1- 2	1.5	8.4- 9.0 oz.	9.0 oz.	9.5 oz.	26
	Kelthane 4F	3	7/14	1	1.0	17.6 oz.	17.6 oz.	17.6 oz.	3
	total dicofol	46	7/14-8/25	1- 2	1.3	8.4-17.6 oz.	9.4 oz.	10.0 oz.	29
dimethoate	Dimethoate 4EC	98	7/14	1	1.0	1.5 lb.	1.5 lb.	1.5 lb.	147
endosulfan	Thiodan 50WP	489	6/23-8/4	1- 4	1.9	.3- 2.0 lb.	9.6 oz.	15.2 oz.	465
fenvalerate	Pydrin 2.4Ec	10	pink	1	1.0	.5- 1.1 oz.	.9 oz.	.9 oz.	1

Table 1.c. Continued

Insecticide	Formulation	Acres treated[a]	Time of application[b]	No. of applications (range)	No. of applications (average)	Rate (ai/A) per application (range)	Rate (ai/A) per application (average)	Rate (ai/A) per year (average)	Total pounds active ingredient /year[c]
formetanate hydrochloride	Carzol SP	1,062	petal fall-8/18	1- 2	1.3	4.4-22.1 oz.	11.8 oz.	12.5 oz.	829
methomyl	Lannate 1.8L	3	6/2	1	1.0	7.2 oz.	7.2 oz.	7.1 oz.	1
	Lannate 90SP	28	6/30, 7/21	1	1.0	1.6-11.4 oz.	2.7 oz.	2.7 oz.	5
	total methomyl	31	6/2-7/21	1	1.0	1.6-11.4 oz.	3.1 oz.	3.1 oz.	6
methyl parathion	Penncap-M	101	5/26-8/25	1- 5	3.0	12.8-16.0 oz.	12.8 oz.	3.4 lb.	344
oxamyl	Vydate L	210	pink-8/18	1- 2	1.2	6.0-24.0 oz.	13.2 oz.	13.2 oz.	173
oxythiquinox	Morestan 25WP	80	pink	1	1.0	1.3 oz.	1.3 oz.	1.3 oz.	7
permethrin	Ambush EC	60	pink	1	1.0	2.5 oz.	2.5 oz.	2.5 oz.	9
	Pounce 3.2EC	897	tight cluster-petal fall	1- 2	1.4	.5- 2.4 oz.	1.7 oz.	2.3 oz.	129
	Pounce 25WP	40	pink	1	1.0	1.0 oz.	1.0 oz.	1.0 oz.	3
	total permethrin	997	tight cluster-petal fall	1- 2	1.3	.5- 2.5 oz.	1.7 oz.	2.2 oz.	137
phosmet	Imidan 50WP	565	tight cluster-9/8	1- 7	3.6	.2- 2.3 lb.	1.0 lb.	1.8 lb.	1,017
phosphamidon	Phosphamidon	543	6/30-7/7	1	1.0	3.0-12.0 oz.	9.0 oz.	9.0 oz.	305

Table 1.c. Continued

Insecticide	Formulation	[a] Acres treated	[b] Time of application	No. of applications (range)	No. of applications (average)	Rate (ai/A) per application (range)	Rate (ai/A) per application (average)	Rate (ai/A) per year (average)	[c] Total pounds active ingredient /year
propargite	Omite 6E	254	6/16-7/28	1- 2	1.7	.4- 1.1 lb.	1.1 lb.	2.3 lb.	584
	Omite 30WP	895	6/2-9/8	1- 3	1.6	.3- 2.1 lb.	1.0 lb.	1.4 lb.	1,253
	total propargite	1,149	6/2-9/8	1- 3	1.6	.3- 2.1 lb.	1.0 lb.	1.6 lb.	1,838
superior oil	Superior Oil 60-7sec Sunspray Oil 6E Dormant Oil Spray Oil	1,329	silver tip-8/4	1- 4	1.3	4.3-63.9 lb.	25.6 lb.	29.1 lb.	38,668
total insecticides (not including superior oil)			-	-	-	-	-	-	10,961

Table 1.d. Timing, number, and rates of growth regulator applications based on active ingredient

Growth regulator	Formulation	[a] Acres treated	[b] Time of application	No. of applications (range)	No. of applications (average)	Rate (ai/A) per application (range)	Rate (ai/A) per application (average)	Rate (ai/A) per year (average)	[c] Total pounds active ingredient /year
carbaryl	Sevin 50WP	203	petal fall-8/25	1- 4	1.8	.9- 4.0 lb.	1.7 lb.	1.7 lb.	345
naphthalene-acetic acid	Fruitone-N	257	petal fall-6/9, 9/15	1- 2	1.2	.1- .4 oz.	.3 oz.	.3 oz.	5
	Klingtite 256	52	5/19, 9/15	2	2.0	.1 oz.	.1 oz.	.2 oz.	1
	total NAA	309	petal fall-6/9, 9/15	1- 2	1.3	.1- .4 oz.	.3 oz.	.3 oz.	6
total growth regulators		-	-	-	-	-	-	-	351

Table 1.e. Timing, number, and rates of rodenticide applications based on active ingredient

Rodenticide	Formulation	[a] Acres treated	[b] Time of application	No. of applications (range)	No. of applications (average)	Rate (ai/A) per application (range)	Rate (ai/A) per application (average)	Rate (ai/A) per year (average)	[c] Total pounds active ingredient /year
chlorphacinone	Rozol Parafinized Pellets	175	1/6, 2/24, 11/17-12/29	6	6.0	.002-.003 oz.	.002 oz.	.01 oz.	.1
zinc phosphide	Orchard Mouse Bait, Zinc Phosphide	474	4/90, 8/4, 11/10-12/8	1- 2	1.1	1.9- 4.8 oz.	3.5 oz.	3.5 oz.	103.7
total rodenticides		-	-	-	-	-	-	-	103.8

Table 1.f. Timing, number, and rates of micronutrient applications based on formulation

Micronutrient	Formulation	Acres treated[a]	Time of application[b]	No. of applications (range)	No. of applications (average)	Rate (form/A) per application (range)	Rate (form/A) per application (average)	Rate (form/A) per year (average)	Total amount formulation per year[d]
calcium	Calcium 6%	7	6/2-8/4	5	5.0	.7 gl.	.7 gl.	3.6 gl.	25 gl.
	Cal Chloride 77-80%	273	6/23-9/22	1- 5	2.0	4.0- 8.0 lb.	6.8 lb.	17.3 lb.	4,723 lb.
	Sorba-Spray Calcium 8%	73	8/4	1	1.0	1.0 qt.	1.0 qt.	1.0 qt.	18 gl.
	total calcium	353	6/2-9/22	1- 5	3.0	-	-	-	-
Nutra-Phos 24	Zn, Ca, P205	175	5/19-7/14	2- 3	2.5	3.0- 7.0 lb.	3.0 lb.	8.7 lb.	1,523 lb.
Nutra-Phos Super K Powder	12.5% Zn, 16% N, 13% P205, 34.5% K20	175	6/2, 6/23	2	2.0	3.0 lb.	3.0 lb.	5.2 lb.	910 lb.
Nutra-Phos Mg Powder	5.5% Zn, 5.5% Mg, 10.5% Ca, 25% P205	175	7/14	1	1.0	3.2 lb.	3.2 lb.	3.2 lb.	560 lb.
Solubor	20.5% B	13	bloom-7/14	1- 2	1.5	1.4- 5.0 lb.	2.5 lb.	3.8 lb.	49 lb.
Sorba-Spray CaB	.5% B, 5% Ca	175	6/2-7/14	3	3.0	1.0 qt.	1.0 qt.	2.8 qt.	123 gl.
Sorba-Spray ZBK	1% B, 1% Zn, 1.5% N, 6% K20	178	6/2, 7/14	1	1.0	1.0 qt.	1.0 qt.	1.0 qt.	45 gl.
Zinc Chelate	9% Liquid	6	6/16, 7/7	2	2.0	1.1 qt.	1.1 qt.	2.1 qt.	3 gl.

Table 1.a.-f. Footnotes

[a] Acres treated is a projection from 297 acres represented by growers as representative of total orchard treated (1,685.8 A).

[b] The dates expressed are the week ending dates that a chemical was used.

[c] Calculated on acres treated x rate (ai/A) per year.

[d] Calculated on acres treated x rate (form/A) per year.

Table 2.a. Use and cost of fungicides by formulation

Fungicide	Formulation	Formulation cost/ unit [a]	Rate/A/ application (average)	Formulation cost/A/ application	Rate/A/ year (average)	Formulation cost/A/ year	Acres treated [b]	Total amount formulation applied/year [c]	Total formulation cost/year [d]
benomyl	Benlate 50WP, 50DF	$ 16.76 lb.	4.8 oz.	$ 5.03	1.7 lb.	$ 28.49	1,249	2,123 lb.	$35,584
captan	Captan 50WP	2.42 lb.	2.5 lb.	6.05	17.4 lb.	42.11	1,093	19,018 lb.	46,026
	Captan 80WP	3.88 lb.	1.5 lb.	5.82	4.4 lb.	17.07	364	1,602 lb.	6,213
	Captec 4L	21.94 gl.	1.0 qt.	5.49	1.0 gl.	21.94	44	44 gl.	965
	total captan	-	-	-	-	-	1,501	-	53,204
dodine	Cyprex 65W	10.00 lb.	.9 lb.	9.00	1.9 lb.	19.00	569	1,081 lb.	10,811
fenarimol	Rubigan EC	291.75 gl.	4.2 fl. oz.	9.57	16.9 fl. oz.	38.52	1,014	134 gl.	39,059
ferbam	Ferbam 76WP, Carbamate WDG	3.29 lb.	2.2 lb.	7.24	4.4 lb.	14.48	160	704 lb.	2,317
mancozeb	Dithane DF	2.85 lb.	1.3 lb.	3.71	4.0 lb.	11.40	6	24 lb.	68
	Dithane M-45	2.46 lb.	1.1 lb.	2.71	3.4 lb.	8.36	23	78 lb.	192
	Manzate 200DF	2.90 lb.	2.4 lb.	6.96	6.6 lb.	19.14	40	264 lb.	766
	Penncozeb 80W	2.41 lb.	2.0 lb.	4.82	7.8 lb.	18.80	25	195 lb.	470
	total mancozeb	-	-	-	-	-	94	-	1,496
mancozeb/ dinocap	Dikar WP	2.73 lb.	2.6 lb.	7.10	2.8 lb.	7.64	175	490 lb.	1,337
metiram	Polyram 80DF	2.33 lb.	3.0 lb.	6.99	9.0 lb.	20.97	50	450 lb.	1,049
myclobutanil	Nova 40W	3.85 oz.	4.1 oz.	15.79	9.6 oz.	36.96	935	561 lb.	34,558
sulfur	Sulfur 83WP	.24 lb.	3.0 lb.	.72	3.3 lb.	.79	182	601 lb.	144
thiophanate-methyl	Topsin M 70WP	16.47 lb.	8.6 oz.	8.85	1.2 lb.	19.76	391	469 lb.	7,726
thiram	Thiram 65WP	3.18 lb.	2.9 lb.	9.22	7.4 lb.	23.53	1,442	10,671 lb.	33,930
total fungicides		-	-	-	-	-	-	-	221,215

Table 2.b. Use and cost of herbicides by formulation

Herbicide	Formulation	[a] Formulation cost/ unit	Rate/A/ application (average)	Formulation cost/A/ application	Rate/A/ year (average)	Formulation cost/A/ year	[b] Acres treated	[c] Total amount formulation applied/year	[d] Total formulation cost/year
2,4-D	Dacamine 4D	$ 23.00 gl.	2.0 qt.	$ 11.50	2.0 qt.	$ 11.50	24	12 gl.	$ 276
dichlobenil	Casoron 4G	1.63 lb.	113.0 lb.	184.19	113.0 lb.	184.19	1	113 lb.	184
diuron	Karmex DF	4.76 lb.	3.0 lb.	14.28	3.0 lb.	14.28	101	303 lb.	1,442
glyphosate	Roundup	56.38 gl.	1.1 qt.	15.51	1.1 qt.	15.51	44	12 gl.	682
oryzalin	Surflan A.S.	67.05 gl.	1.0 gl.	67.05	1.0 gl.	67.05	8	8 gl.	536
paraquat	Gramoxone Super	36.00 gl.	1.3 qt.	11.70	1.3 qt.	11.70	110	36 gl.	1,287
simazine	Princep 80W	3.20 lb.	2.5 lb.	8.00	2.5 lb.	8.00	3	8 lb.	24
	Princep Caliber 90, Simazine 90G	3.57 lb.	2.0 lb.	7.14	2.0 lb.	7.14	51	102 lb.	364
	total simazine	-	-	-	-	-	54	-	388
terbacil	Sinbar 80WP	25.70 lb.	3.1 lb.	79.67	3.1 lb.	79.67	83	257 lb.	6,613
total herbicides		-	-	-	-	-	-	-	11,408

Table 2.c. Use and cost of insecticides by formulation

Insecticide	Formulation	Formulation cost/ unit [a]	Rate/A/ application (average)	Formulation cost/A/ application	Rate/A/ year (average)	Formulation cost/A/ year	Acres treated [b]	Total amount formulation applied/year [c]	Total formulation cost/year [d]
azinphos-methyl	Azinphos-methyl 35WP, Guthion 35WP	$ 4.83 lb.	1.6 lb.	$ 7.33	7.9 lb.	$ 38.16	448	3,539 lb.	$17,096
	Azinphos-methyl 50WP Guthion 50WP	6.76 lb.	1.1 lb.	7.44	6.8 lb.	45.97	1,141	7,759 lb.	52,452
	total azinphos-methyl	-	-	-	-	-	1,589	-	69,548
carbaryl [e]	Sevin 4F	24.30 gl.	.7 pt.	2.13	.7 pt.	2.13	52	5 gl.	111
chlorpyrifos	Lorsban 4E	47.32 gl.	1.3 pt.	7.69	1.3 pt.	7.69	317	52 gl.	2,438
	Lorsban 50W	5.29 lb.	1.1 lb.	5.82	1.8 lb.	9.52	354	637 lb.	3,370
	total chlor-pyrifos	-	-	-	-	-	671	-	5,808
cyhexatin	Plictran 50W	19.85 lb. [f]	1.0 lb.	19.85	2.0 lb.	39.70	25	50 lb.	993
dicofol	Kelthane 35WP	7,95 lb.	1.6 lb.	12.72	1.7 lb.	13.52	43	73 lb.	581
	Kelthane 4F	41.00 gl. [f]	2.2 pt.	11.28	2.2 pt.	11.28	3	7 pt.	34
	total dicofol	-	-	-	-	-	46	-	615
dimethoate	Dimethoate 4EC	31.11 gl.	2.9 pt.	11.28	2.9 pt.	11.28	98	36 gl.	1,105
endosulfan	Thiodan 50WP	6.00 lb.	1.2 lb.	7.20	1.9 lb.	11.40	489	929 lb.	5,575
fenvalerate	Pydrin 2.4EC	65.00 gl.	3.1 fl. oz.	1.57	3.1 fl. oz.	1.57	10	2 pt.	16
formetanate hydrochloride	Carzol SP	32.78 lb.	.8 lb.	26.22	.9 lb.	29.50	1,062	956 lb.	31,329

Table 2.c. Continued

Insecticide	Formulation	Formulation cost/unit [a]	Rate/A/application (average)	Formulation cost/A/application	Rate/A/year (average)	Formulation cost/A/year	Acres treated [b]	Total amount formulation applied/year [c]	Total formulation cost/year [d]
methomyl	Lannate 1.8L	$ 41.11 gl.	2.0 pt.	$ 10.28	2.0 pt.	$ 10.28	3	6 pt.	$ 31
	Lannate 90SP	20.51 lb.	3.0 oz.	3.85	3.0 oz.	3.85	28	5 lb.	108
	total methomyl	-	-	-	-	-	31	-	139
methyl parathion	Penncap-M	22.70 gl.	1.6 qt.	9.08	6.8 qt.	38.59	101	172 gl.	3,898
oxamyl	Vydate L	58.12 gl.	3.3 pt.	23.97	3.3 pt.	23.97	210	87 gl.	5,034
oxythiquinox	Morestan 25WP	13.23 lb.	5.3 oz.	4.38	5.3 oz.	4.38	80	27 lb.	350
permethrin	Ambush EC	114.55 gl.	10.0 fl. oz.	8.95	10.0 fl. oz.	8.95	60	5 gl.	537
	Pounce 3.2EC	187.05 gl.	4.3 fl. oz.	6.28	5.7 fl. oz.	8.33	897	40 gl.	7,472
	Pounce 25WP	14.58 lb.	4.1 oz.	3.74	4.1 oz.	3.74	40	10 lb.	150
	total permethrin	-	-	-	-	-	997	-	8,159
phosmet	Imidan 50WP	3.57 lb.	2.0 lb.	7.14	3.6 lb.	12.85	565	2,034 lb.	7,260
phosphamidon	Phosphamidon [g]	82.50 gl.	9.0 fl. oz.	5.80	9.0 fl. oz.	5.80	543	38 gl.	3,149
propargite	Omite 6E	90.17 gl.	1.5 pt.	16.91	3.0 pt.	33.81	254	95 gl.	8,588
	Omite 30WP	5.11 lb.	3.3 lb.	16.86	4.8 lb.	24.53	895	4,296 lb.	21,954
	total propargite	-	-	-	-	-	1,149	-	30,542
superior oil	Superior Oil 60-70sec Sun Spray Oil 6E Dormant Oil, Spray Oil	7.64 gl.	3.6 gl.	27.50	4.1 gl.	31.32	1,329	5,449 gl.	41,624
total insecticides (not including superior oil)			-	-		-	-	-	173,630

Table 2.d. Use and cost of growth regulators by formulation

Growth regulator	Formulation	Formulation cost/unit [a]	Rate/A/application (average)	Formulation cost/A/application	Rate/A/year (average)	Formulation cost/A/year	Acres treated [b]	Total amount formulation applied/year [c]	Total formulation cost/year [d]
carbaryl [e]	Sevin 50WP	$ 2.90 lb.	3.4 lb.	$ 9.86	3.4 lb.	$ 9.86	203	690 lb.	$ 2,002
naphthalene-acetic acid	Fruitone N	8.18 lb.	9.6 oz.	4.91	9.6 oz.	4.91	257	154 lb.	3,747
	Klingtite 256	111.56 gl.	2.0 fl. oz.	1.74	2.7 fl. oz.	2.35	52	1 gl.	122
	total NAA	-	-	-	-	-	309	-	1,384
total growth regulators		-	-	-	-	-	-	-	3,386

Table 2.e. Use and cost of rodenticides by formulation

Rodenticide	Formulation	Formulation cost/unit [a]	Rate/A/application (average)	Formulation cost/A/application	Rate/A/year (average)	Formulation cost/A/year	Acres treated [b]	Total amount formulation applied/year [c]	Total formulation cost/year [d]
chlorphacinone	Rozol Parafinized Pellets	$ 1.29 lb.	2.8 lb.	$ 3.61	16.6 lb.	$ 21.41	175	2,905 lb.	$ 3,747
zinc phosphida	Orchard Mouse Bait, Zinc Phosphide	.70 lb.	10.8 lb.	7.56	10.9 lb.	7.63	474	5,167 lb.	3,617
total rodenticides		-	-	-	-	-	-	-	7,364

Table 2.f. Use and cost of micronutrients by formulation

Micro-nutrients	Formulation	Formulation cost/ unit [a]	Rate/A/ application (average)	Formulation cost/A/ application	Rate/A/ year (average)	Formulation cost/A/ year	Acres treated [b]	Total amount formulation applied/year [c]	Total formulation cost/year [d]
calcium	Calcium 6%	$ 7.00 gl.	.7 gl.	$ 4.90	3.6 gl.	$ 25.20	7	25 gl.	$ 176
	Cal Chloride 77-80%	.29 lb.	6.8 lb.	1.97	17.3 lb.	5.02	273	4,723 lb.	1,370
	Sorba-Spray Ca	9.14 gl.	1.0 qt.	2.29	1.0 qt.	2.29	73	18 gl.	167
	total calcium	-	-	-	-	-	353	-	1,713
Nutra-Phos 24	Zn, Ca, P205	1.37 lb.	3.0 lb.	4.11	8.7 lb.	11.92	175	1,523 lb.	2,086
Nutra-Phos Super K Powder	12.5% Zn, 16% N, 13% P205, 34.5% K20	1.63 lb.	3.0 lb.	4.89	5.2 lb.	8.48	175	910 lb.	1,484
Nutra-Phos Mg Powder	5.5% Zn, 5.5% Mg, 10.5% Ca, 25% P205	1.47 lb.	3.2 lb.	4.70	3.2 lb.	4.70	175	560 lb.	823
Solubor	20.5% B	.78 lb.	2.5 lb.	1.95	3.8 lb.	2.96	13	49 lb.	38
Sorba-Spray CaB	.5% B, 5% Ca	10.61 gl.	1.0 qt.	2.65	2.8 qt.	7.43	175	123 gl.	1,300
Sorba-Spray ZBK	1% B, 1% Zn, 1.5% N, 6% K20	13.61 gl.	1.0 qt.	3.40	1.0 qt.	3.40	178	45 gl.	605
Zinc Chelate	9% Liquid	12.94 gl.	1.1 qt.	3.56	2.1 qt.	6.79	6	3 gl.	41
total micronutrients		-	-	-	-	-	-	-	8,090

Table 2.a.-f. Footnotes

[a] Source: Connecticut retailers who sell agricultural chemicals (August, 1991) unless otherwise footnoted.

[b] Acres treated is a projection from 297 acres represented by growers as representative of total orchard treated (1,685.8 A).

[c] Calculated on rate/acre/year x acres treated.

[d] Calculated on formulated cost/acre/year x acres treated.

[e] Carbaryl is listed under insecticides and growth regulators. Combined formulation cost/year is $2,122.31.

[f] Source: Connecticut retailers who sell agricultural chemicals (1986).

[g] Source: Connecticut retailers who sell agricultural chemicals (September, 1990).

Table 3.a. Fungicide: percent of acreage treated by application method

Fungicide	Formulation	Air blast	Handgun
benomyl	Benlate 50WP	98	2
	Benlate 50DF	98	2
captan	Captan 50WP	99	1
	Captan 80WP	96	4
	Captec 4L	100	
dodine	Cyprex 65WP	98	2
fenarimol	Rubigan EC	100	
ferbam	Ferbam 76WP	94	6
	Carbamate WDG	100	
mancozeb	Dithane DF	100	
	Dithane M-45	100	
	Manzate 200DF	100	
	Penncozeb 80W	100	
mancozeb/dinocap	Dikar WP	100	
metiram	Polyram 80DF	100	
myclobutanil	Nova 40W	100	
sulfur	Sulfur 83WP	100	
thiophanatemethyl	Topsin M 70WP	100	
thiram	Thiram 65WP	92	8

Table 3.b. Herbicide: percent of acreage treated by application method

Herbicide	Formulation	Handgun	Boomsprayer or other
2,4-D	Dacamine 4D		100
dichlobenil	Casoron 4G		100
diuron	Karmex DF		100
glyphosate	Roundup	21	79
oryzalin	Surflan A.S.	100	
paraquat	Gramoxone Super	7	93
simazine	Princep 80W	100	
	Princep 90 Caliber		100
	Simazine 90G		100
terbacil	Sinbar	4	96

Table 3.c. Insecticide: percent of acreage treated by application method

Insecticide	Formulation	Air blast	Handgun
azinphosmethyl	Azinphosmethyl 35WP	100	
	Guthion 35WP	100	
	Azinphosmethyl 50WP	100	
	Guthion 50WP	100	
carbaryl	Sevin 4F	100	
chlorpyrifos	Lorsban 4E	100	
	Lorsban 50W	100	
cyhexatin	Plictran 50W	100	
dicofol	Kelthane 35WP	100	
	Kelthane 4F	100	
dimethoate	Dimethoate 4EC	100	
endosulfan	Thiodan 50WP	98	2
fenvalerate	Pydrin 2.4EC	100	
formetanate hydrochloride	Carzol SP	100	
methomyl	Lannate 1.8L		100
	Lannate 90SP	100	
methyl parathion	Penncap-M	100	
oxamyl	Vydate L	90	10
oxythiquinox	Morestan 25WP	100	
permethrin	Ambush EC	100	
	Pounce 3.2EC	100	
	Pounce 25WP	100	
phosmet	Imidan 50WP	100	
phosphamidon	Phosphamidon	100	
propargite	Omite 6E	100	
	Omite 30WP	98	2
superior oil	Superior Oil 60-70sec, Sun Spray Oil 6E, Dormant Oil, Spray Oil	100	

Table 4.a. Expected changes in quality, yield, and cost with the use of alternative fungicides and/or methods

Fungicide	Alternate pesticide and/or method	Expected change in quality with alternate				Expected change in yield with alternate				Expected change in cost with alternate			
		No chg.	Inc.	Dec.	Don't know	No chg.	Inc.	Dec.	Don't know	No chg.	Inc.	Dec.	Don't know
benomyl	Topsin-M	x				x				x			
captan	Carbamate			10%		x					x(20% labor)		
	Thiram			x				x			x(rot-sorting cost)		
	Sulfur			x				x			x(rot-sorting cost)		
	None. Captan is superior for control of the blossom end rot.												
dodine	Benlate	x				x					20%		
	Captan		25%			x						20%	
	Captan			x(considerable)				x(considerable)		x			
	Ferbam				x				x				x
	Manzate		25%			x						20%	
	Nova				x				x				x
	Sulfur			x					x				x
	Thiram/Benlate			x				x					x
fenarimol	Benlate	x				x						x	
	Captan			15%		x							x
	Manzate 200		25%			x						50%	
	Nova	x				x					x		
	Nova	x				x				x			
	Nova	x				x					x(10-20% product)		
ferbam	Manzate 200		25%			x						20%	
	Rubigan		4-10%			x					30%		
	Disease resistant varieties			x					x				x
myclobutanil	Rubigan	x				x					27%		
	Thiram			x				x				x	
thiophanate-methyl	Benlate	x				x					20%		

Table 4.a. Continued

Fungicide	Alternate pesticide and/or method	Expected change in quality with alternate				Expected change in yield with alternate				Expected change in cost with alternate			
		No chg.	Inc.	Dec.	Don't know	No chg.	Inc.	Dec.	Don't know	No chg.	Inc.	Dec.	Don't know
thiram	Benlate	x				x					x		
	Benlate				x			x					x
	Captan	x				x					11%		
	Captan			x				x				x	
	Captan	x				x						x(Captan 1/2 cost of Thiram)	
	Captan				x				x	x			
	Funginex				x				x		x		
	Rubigan				x				x		x		
	None												
captan/ benomyl	Dithane		25%				x						x
	Ferbam				x		x			x			
	Manzate 200		25%				x						x
	Topsin M				x				x		x		
	Funginex/Topsin M				x				x				x
	Thiram/Bayleton				x				x				x
	Thiram/Benlate				x				x				x
	Thiram/Nova			x				x(severe if bitter rot a problem)			x(twice as expensive)		
captan/ fenarimol	Captan		4-10%						x			10%	
	Resistant varieties and remove inoculem.				x				x				x
captan/ myclobutanil	Captan			x				x					x
	Thiram			x				x			x(frequency of spraying)		
	Sulfur			x				x			x(frequency of spraying)		
	Benlate/Thiram				x				x				x
	Captan/Thiram				x				x				x
	Ferbam/Rubigan				x				x				x

Table 4.a. Continued

Fungicide	Alternate pesticide and/or method	Expected change in quality with alternate: No chg.	Inc.	Dec.	Don't know	Expected change in yield with alternate: No chg.	Inc.	Dec.	Don't know	Expected change in cost with alternate: No chg.	Inc.	Dec.	Don't know
captan/ thiophanate-methyl	Thiram			x				x			x(frequency of spraying)		
	Sulfur			x				x			x(frequency of spraying)		
captan/ thiram	Benlate/Captan			x				x					x
dodine/ myclobutanil	Sulfur/Benlate			x					x				x
fenarimol/ ferbam/ thiophanate-methyl	Thiram			x				x			x(frequency of spraying)		
	Sulfur			x				x			x(frequency of spraying)		
thiram/ dodine	Captan/Ferbam			x				x			x		
thiram/ fenarimol	Captan				x				x			x	
	Fuginex				x				x		x		
	Benlate/Captan	x				x				x			
	Nova combination				x				x		x		
	Resistant varieties and cut down wild trees, remove cedars within 1/2 mile.				x				x				x
thiram/ myclobutanil	Ferbam			x(moderate)				x(slight-fruit abort from infection)				x(Nova cost = $25/A)	
	Thiram			x(moderate)				x(slight-fruit abort from infection)				x	
thiram/ thiophanate-methyl	Captan/Topsin-M	x				x				11%			

COMMENT(S): "With EBDC you used one material on summer diseases, now have to use combination of materials."

"Preventive fungicide (Thiram or Captan/Benlate) will increase one's cost because you have to spray every 7 days vs. 10 days cycle with Thiram or Captan plus Rubigan or Nova."

"Mancozeb needs to come back."

"With dithiocarbamates off the market, there are very few good fungicides left. The new sterol inhibitors are very expensive."

Table 4.b. Expected changes in quality, yield, and cost with the use of alternative herbicides and/or methods

Herbicide	Alternate pesticide and/or method	Expected change in quality with alternate				Expected change in yield with alternate				Expected change in cost with alternate			
		No chg.	Inc.	Dec.	Don't know	No chg.	Inc.	Dec.	Don't know	No chg.	Inc.	Dec.	Don't know
2, 4-D	Hoeing	x				x					x		
glyphosate	Mowing	x				x					x		
	Mowing			x				x			x(to many man hours)		
	Mow				x				x				x
	Paraquat	x				x				x			
paraquat	Mowing			x(small am't)				x(small am't)					x
	Roundup		x			x					25%		
	Roundup	x				x							x
simazine	Sinbar/Karmex	x				x					100%		
terbacil	Simazine			x		x						x	
terbacil/ diuron	Princep/Surflan/ Roundup			x				x					x
	Paraquat			x				x					x
terbacil/ simazine	Surflan	x							x				x

COMMENT(S): "Casaron, Simazine, Paraquat. There is a good selection of herbicides to choose from and I alternate every year. Herbicides are only used under the trees where mowing is not possible."

Table 4.c. Expected changes in quality, yield, and cost with the use of alternative insecticides and/or methods

Insecticide	Alternate pesticide and/or method	Expected change in quality with alternate				Expected change in yield with alternate				Expected change in cost with alternate			
		No chg.	Inc.	Dec.	Don't know	No chg.	Inc.	Dec.	Don't know	No chg.	Inc.	Dec.	Don't know
azinphosmethyl	Imidan			x					x				x
	Imidan			x					x		x		
	Imidan	x				x				x			
	Imidan	x				x				x			
	Imidan			x				x				x	
	Imidan				x				x				x
	Imidan	x				x							x
	Imidan			x				x					x
	Imidan	x				x							x
	Imidan			x		x				x			
	Imidan				x				x		x		
	Lorsban	x				x					x(slight)		
	Lorsban	x				x					16%		
	Lorsban	x				x							x
	Methoxychlor				x				x		x		
	Pounce				x				x				x
	Pyrethroids	x				x							x
	Safer Soap			15-30%		x					26%		
	Sevin			x				x					x
	Thiodan			x				x			x		
	Thiodan			x				x					x
	None												
	Trap or monitor sawfly, curculio to time spray.	x				x				x			
	Trap for cuddling moth, apple maggot (no traps for leafminers).			x					x		x		
carbaryl	No alternate												

Table 4.c. Continued

Insecticide	Alternate pesticide and/or method	Expected change in quality with alternate				Expected change in yield with alternate				Expected change in cost with alternate			
		No chg.	Inc.	Dec.	Don't know	No chg.	Inc.	Dec.	Don't know	No chg.	Inc.	Dec.	Don't know
chlorpyrifos	Diazinon			x				x					x
	Guthion			10%		x					x(need 2nd material for aphids)		
	Imidan			25% (not as effective on several insects)		x					10%		
	Sevin			x				x				x	
	No alternate												
dicofol	Carzol				x				x				x
	Omite			x					x				x
	Omite				x				x				x
dimethoate	Sevin (hard on predators)	x				x							x
	Thiodan/Guthion	x				x					x		
	Thiodan/Imidan	x				x					x		
	Thiodan/Penncap	x				x					x		
endosulfan	Penncap M		x			x				x			
	Phosphamidon			x		x					x		
	Phosphamidon		x				x				x		
	Pounce			x					x				x
	Sevin			x				x				x	
	No alternate												

Table 4.c. Continued

Insecticide	Alternate pesticide and/or method	Expected change in quality with alternate: No chg.	Inc.	Dec.	Don't know	Expected change in yield with alternate: No chg.	Inc.	Dec.	Don't know	Expected change in cost with alternate: No chg.	Inc.	Dec.	Don't know
formentanate hydrochloride	Kelthane				x				x				x
	Kelthane				x				x			6%	
	Kelthane			x				x		x			
	Omite			x		x				x			
	Omite			x		x						x(but less effective)	
	Superior Oil (July, August)			x					x				x
	Encourage or introduce predators				x				x				x
methomyl	Pyrethroids	x				x							x
	Vydate				x				x				x
	Vydate		x(longer residual)				x				x		
	None												
methyl parathion	Guthion (overuse speeds resistance by some pests)	x				x					x(slight)		
	Imidan	x				x							x
	Imidan/Guthion	x				x				x			
	Trapout apple maggot			x		x					x(depend on how much time spent and lifespan of trap)		
oxamyl	Lannate	x				x					x		
	Lannate (very hard on mites)	x						x(timing critical, if leafminer severe enough, will cause fruit drop)					x
	Lorsban	x				x					x		
	Pyrethroids	x				x							x
	None												

Table 4.c. Continued

Insecticide	Alternate pesticide and/or method	Expected change in quality with alternate				Expected change in yield with alternate				Expected change in cost with alternate			
		No chg.	Inc.	Dec.	Don't know	No chg.	Inc.	Dec.	Don't know	No chg.	Inc.	Dec.	Don't know
permethrin	Guthion (doesn't control leafminer)			x				x				18%	
	Guthion			x				x				x	
	Guthion				x				x				x
	Imidan			x				x				x	
	Thiodan			x				x				x	
	Pydrin	x				x					x		
	Vydate	x				x					x(considerable)		
	Guthion/Vydate				x	x					x		
	Guthion/Vydate	x				x					x(double)		
	Trap leafminer and plant bug to determine if application is necessary.				x				x			x(if application is skipped)	
phosmet	Guthion			x				x				x	
	Guthion				x				x				x
	Guthion	x				x				x			
	Lannate				x				x				x
	Lorsban	x				x				x			
	Methoxychlor				x				x		x		
	Pyrethroids	x				x							x
	IPM scouting		5%				x					x(-10% product, +20% labor)	
	Traps				x				x				x
	Use baited red sphere traps to trap out apple maggot populations.				x				x				x
phosphamidon	Use natural predators to take care.	x				x						x(cost of pesticide)	

Table 4.c. Continued

Insecticide	Alternate pesticide and/or method	Expected change in quality with alternate				Expected change in yield with alternate				Expected change in cost with alternate			
		No chg.	Inc.	Dec.	Don't know	No chg.	Inc.	Dec.	Don't know	No chg.	Inc.	Dec.	Don't know
propargite	Carzol	x				x					x		
	Carzol	x				x					x(a lot)		
	Carzol			x				x					x
	Kelthane	x				x					x		
	Kelthane				x				x				x
	Kelthane			x				x			x		
	Kelthane			x				x			x(considerable)		
	Kelthane			x(little)				x(little)			x(little)		
	Kelthane				x				x				x
	Kelthane	x				x				x			
	Morestan				x				x				x
	Superior Oil(July, August)			x					x				x
	Vendex				x				x				x
	Vendex			x				x					x
	Predators			10%		x				x			
	Predators				x				x				x
	Use more predators (i.e. Stethorus punctum, Amblyseius fallacis) to possibly take care of total mite population.				x				x				x
	A new miticide/ovicide. Omite 6E residual is short and multiple applications required.												
	None												

Table 4.c. Continued

Insecticide	Alternate pesticide and/or method	Expected change in quality with alternate				Expected change in yield with alternate				Expected change in cost with alternate			
		No chg.	Inc.	Dec.	Don't know	No chg.	Inc.	Dec.	Don't know	No chg.	Inc.	Dec.	Don't know
superior oil	Carzol			x				x			x(increased frequency of spraying)		
	Kelthane		x				x				x(increased frequency of spraying)		
	Skip application			50%				1-100%				100%	
	None												
	None												
	None												
	None												
	None												
	None												
	No alternative												
	No alternative												
azinphosmethyl/ chlorpyrifos	Vydate			x				x		x			
superior oil/ chlorpyrifos	Oil alone			x(reduced effectiveness on aphid, mite, scales)				x				x(cost of Lorsban=$10/A)	

Table 4.d Expected changes in quality, yield, and cost with the use of alternative growth regulators and/or methods

Growth regulator	Alternate pesticide and/or method	Expected change in quality with alternate: No chg.	Inc.	Dec.	Don't know	Expected change in yield with alternate: No chg.	Inc.	Dec.	Don't know	Expected change in cost with alternate: No chg.	Inc.	Dec.	Don't know
carbaryl	NAA				x				x				x
	None												
naphthalene-acetic acid	Alar		60%				20%				x		
	Amid Thin			15%		x						5-10%	
	Amid Thin			x				x					x
	NAD			x				x					x
	Sevin			x(much)				x		x			
	Hand thinning			x(size loss)				x(small size)				x(labor at $200/A)	
	Hand thinning			25-30%			10%					x(30-50% or more)	
	None												

COMMENT(S): "Alar needs to come back."

Table 4.e. Expected changes in quality, yield, and cost with the use of alternative rodenticides and/or methods

Rodenticide	Alternate pesticide and/or method	Expected change in quality with alternate: No chg.	Inc.	Dec.	Don't know	Expected change in yield with alternate: No chg.	Inc.	Dec.	Don't know	Expected change in cost with alternate: No chg.	Inc.	Dec.	Don't know
zinc phosphide	Close mowing			x(little)				x(little)			x(lot)		
	Hand trail baiting	x				x					x(lot)		

Table 4.a.-f. General comments

GENERAL COMMENTS:	"The apple orchard is a part time business. We use a spray schedule rather than IPM because spraying is limited primarily to weekends."
	"Mites and scab are my #1 pest control problems."
	"Alternate middle sprays saves one or two cover sprays by blowing through trees and treating at least 75% of tree."
	"Alternatives not considered due to lack of time."
	"I have been working with the orchards since 1965 and I would have the following observations: First, you cannot possibly grow apples without spraying. Second, public in this area will not buy any apples which is visually defective."
	"If I can't get the necessary chemicals, I'll get out of the business."

Table 5.a. Number of acres and number of applications by fungal disease

Common name	No. of acres treated[a]	Percent of acres treated	No. of applications/acre (range)	No. of applications/acre (average)
Apple scab	1,219	100.0	5-18	9.1
Apple rusts	1,125	92.3	1-12	4.3
Bitter rot	304	24.9	1-11	5.0
Black rot	742	60.8	1-19	5.9
Calyx end rot	371	30.4	1- 2	1.5
Fly speck	959	78.7	2-19	5.6
Fruit rots	450	36.9	3	3.0
Powdery mildew	837	68.6	1-10	4.8
Sooty blotch	962	79.0	1-19	4.9
Summer diseases	114	9.4	1- 7	4.4
White rot	40	3.3	2	2.0

Table 5.b. Number of acres and number of applications for weeds

Common name	No. of acres treated[b]	Percent of acres treated	No. of applications/acre (range)	No. of applications/acre (average)
Weeds	137	9.2	1- 2	1.1

Table 5.c. Number of acres and number of applications by insect pest

Common name	No. of acres treated[b]	Percent of acres treated	No. of applications/acre (range)	No. of applications/acre (average)
Aphids				
Green apple aphid	355	23.8	1- 3	1.8
Rosy apple aphid	592	39.8	1- 3	1.6
Wooly apple aphid	3	.2	1	1.0
Aphids	487	32.7	1- 6	2.3
total aphids	1,359[c]	91.2	1- 6	2.3
Apple maggot fly	1,489	100.0	1-11	3.8
Borers	282	18.9	1- 3	2.0
Codling moth	1,137	76.4	1-11	3.4
European apply sawfly	1,158	77.7	1- 4	1.6
Green fruitworms	797	53.5	1- 3	2.1
Leafhoppers	1,104	74.2	1- 3	1.6
Leafminers	1,329	89.2	1- 3	1.4
Leafrollers	1,086	72.9	1-12	3.7
Mites				
European red mite	1,040	69.9	1-11	3.2
Two-spotted mite	176	11.8	1- 2	1.8
McDonald mite	6	.4	2	2.0
Mites	535	35.9	1- 7	2.5
total mites	1,207[c]	81.1	1-11	3.5
Plant bug	1,087	73.0	1- 4	1.5
Plum curculio	1,469	98.7	1- 8	3.4
Scales	847	56.9	1- 4	1.6

Table 5.d. Number of acres and number of applications by growth regulator

Common name	No. of acres treated[b]	Percent of acres treated	No. of applications/acre (range)	No. of applications/acre (average)
Pre-harvest drop	76	5.1	1	1.0
Thinning	254	17.1	1- 2	1.1

Table 5.e. Number of acres and number of applications by rodents

Common name	No. of acres treated[b]	Percent of acres treated	No. of application/acre (range)	No. of applications/acre (average)
Rodents (vole & mice)	238	16.0	1- 2	1.1

Table 5.f. Number of acres and number of applications by micronutrients

Common name	No. of acres treated[b]	Percent of acres treated	No. of applications/acre (range)	No. of applications/acre (average)
Boron	48	3.2	1- 2	1.3
Calcium	155	10.4	1- 5	2.7
Zinc chelate	6	.4	2	2.0

Table 5.a.-f. Footnotes

a
Acres treated is a projection from 229 acres represented by growers as representative of total orchard treated (1,218.8 A).

b
Acres treated is a projection from 239 acres represented by growers as representative of total orchard treated (1,488.8 A).

c
This figure is less than the total of the above acres; because, occasionally two or more species were treated for on the same acre.

SECTION A: General Instructions

1. Please choose one block in your apple orchard that roughly approximates your operation in 1990. The block needs to be apple bearing trees.
2. Report every application of every pesticide used in 1990 for the block you choose. This includes herbicides, insecticides, fungicides, miticides, rodenticides, oils, thinners, etc.
3. Record all units in ounces, pounds, pints or gallons.
4. Label Rate: Provide the label rate of unmixed material per 100 gal or per acre. Typical answer might be 6 lbs/100 gal (6 pounds of unmixed material per 100 gal of water). Remember to record unit of measurment (i.e. lb/100 gal or gal/acre).
5. Actual Rate: How much material did you actually put in the tank per 100 gallons concentrate mix (or per 100 gallons dilute mix if applied dilute)? Record all units as lbs/100 gal, oz/100 gal, gal/100gal, or pt/100 gal.
6. Acres Treated: if you sprayed herbicides in strips or bands, only report the actual area sprayed.
7. If you come across a question which you cannot answer, please continue filling out the form as completely as you possibly can.

SECTION B: 1990 Regular Spary Program Information

Block

Block name: _____

Block size: _____ acres

Block production harvested: _____ bushels

Block production not harvested: _____ bushels

Gross income per harvested bushel: _____ dollars

Orchard

Total area of apple bearing trees sprayed: _____ acres

Total production harvested: _____ bushels

Total production not harvested _____ bushels

Average gross income per harvested bushel _____ dollars

Date and Growth Stage	Trade Name and Formulation (Ex. Captan 50W)	Label Rate (See instruction #4)	Your Actual Rate per 100 Gal (see instruction #5	Gallons of Mix per Acre	Acres Treated (see instruction #6)	Type of Application (check column)			All Pest(s) Targeted (specific name of weed, insect, fungus, etc.)
						Air Blast	Hand Gun	Other	
									Pest 1
									Pest 2
									Pest 3
									Pest 4
									Pest 5
									Pest 1
									Pest 2
									Pest 3
									Pest 4
									Pest 5

SECTION C: 1990 Alternative Program Information

For each of the pesticides you reported in section B:

What alternative pesticide could have been used?

What alternate, nonchemical method could have been used? (ex. disease resistant varieties, use of purchased natural predators, Bacillus Thuringiensis, removal/shredding of leaves, trapping, mowing instead of herbicide, no treatment, etc.)

Date and Growth Stage	Name of Pesticide Reported in Section B	Alternate Pesticide and/or Method (be specific)	Expected Change in Quality with Alternate (check one)	Expected Change in Yield with Alternate (check one)	Expected Change in Cost with Alternate (check one)
		________ 1st Alternate	No change____ How Much? Increase ____ ________ Decrease ____ ________ Don't Know ____	No change____ How Much? Increase ____ ________ Decrease ____ ________ Don't Know ____	No change____ How Much? Increase ____ ________ Decrease ____ ________ Don't Know ____
		________ 2nd Alternate	No change____ How Much? Increase ____ ________ Decrease ____ ________ Don't Know ____	No change____ How Much? Increase ____ ________ Decrease ____ ________ Don't Know ____	No change____ How Much? Increase ____ ________ Decrease ____ ________ Don't Know ____
		________ 1st Alternate	No change____ How Much? Increase ____ ________ Decrease ____ ________ Don't Know ____	No change____ How Much? Increase ____ ________ Decrease ____ ________ Don't Know ____	No change____ How Much? Increase ____ ________ Decrease ____ ________ Don't Know ____
		________ 2nd Alternate	No change____ How Much? Increase ____ ________ Decrease ____ ________ Don't Know ____	No change____ How Much? Increase ____ ________ Decrease ____ ________ Don't Know ____	No change____ How Much? Increase ____ ________ Decrease ____ ________ Don't Know ____
		________ 1st Alternate	No change____ How Much? Increase ____ ________ Decrease ____ ________ Don't Know ____	No change____ How Much? Increase ____ ________ Decrease ____ ________ Don't Know ____	No change____ How Much? Increase ____ ________ Decrease ____ ________ Don't Know ____
		________ 2nd Alternate	No change____ How Much? Increase ____ ________ Decrease ____ ________ Don't Know ____	No change____ How Much? Increase ____ ________ Decrease ____ ________ Don't Know ____	No change____ How Much? Increase ____ ________ Decrease ____ ________ Don't Know ____