State of California
California Environmental Protection Agency
AIR RESOURCES BOARD

APPENDICES

FOR THE

Report for the Application
and Ambient Air Monitoring
of Malathion in Imperial County

Engineering and Laboratory Branch

Monitoring and Laboratory Division

Project No. C98-003 (Application)
C98-002 (Ambient)

Date: January 28 , 1999

APPENDIX I

SAMPLING PROTOCOL

Cal/EPA
California Environmental Protection Agency

Air Resources Board
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Pete Wilson
Governor

Peter M. Rooney
Secretary for Environmental Protection

MEMORANDUM

TO: Doug Okamura, Chief
Environmental Monitoring and Pest Management Branch
Department of Pesticide Regulation

FROM: George Lew, Chief
Engineering and Laboratory Branch
Monitoring and Laboratory Division

DATE: February 18, 1998

SUBJECT: FINAL PROTOCOLS FOR THE 1998 SIMAZINE AIR MONITORING IN FRESNO COUNTY AND MALATHION/MALAOXON AIR MONITORING IN IMPERIAL COUNTY

Attached are the final protocols, "Protocol for the Application (Ventura County) and Ambient (Fresno County) Air Monitoring of Simazine During Winter, 1998" and "Protocol for the Application and Ambient Air Monitoring of Malathion and Malaoxon in Imperial County During Winter, 1998".

We received the FAX transmissions of the draft "Use Information and Air Monitoring Recommendation for the Pesticide Active Ingredient Malathion and its Breakdown Product Malaoxon" and the draft "Figure 2; Applications of Malathion to Alfalfa and Other Areas in Imperial County" on January 27, 1998 and February 9, 1998 respectively from Kevin Kelly of your staff. We will proceed with the malathion monitoring, which is scheduled to begin February 23, 1998, based on the draft documents listed above. We understand that the final version of the malathion monitoring recommendation will be forwarded by February 13, 1998. Values for the desired target practical quantitation limit (PQL) were not included in the draft monitoring recommendation but are to be included in the final document. While our method development is still in progress for malathion and malaoxon, we feel confident that we can achieve PQLs of 0.50 pptv and 2.5 pptv respectively (assuming a 24 hour

sample at 3 Lpm). We hope that these PQLs are acceptable for your needs.

Due to the close timing of the monitoring schedule we were unable to provide you with an opportunity to comment on draft versions of the above protocols and have forwarded only the final versions (as per the February 6, 1998 conversation between Kevin Mongar and Kevin Kelly of our staffs).

If you or your staff have questions or need further information, please contact me at (916) 263-1630 or Mr. Kevin Mongar at (916) 263-2063.

Attachments

cc: Ray Menebroker, Chief (w/Attachment)
Project Assessment Branch
Stationary Source Division

Cosmo Insalaco (w/Attachment)
Fresno County
Agricultural Commissioner

Steven L. Birdsall (w/Attachment)
Imperial County
Agricultural Commissioner

W. Earl McPhail (w/Attachment)
Ventura County
Agricultural Commissioner

David L. Crow, APCO (w/Attachment)
San Joaquin Valley Unified APCD

Richard H. Baldwin, APCO (w/Attachment)
Ventura County APCD

bcc: Bill Loscutoff, MLD (w/o)
Peter Venturini, SSD (w/o)
Peter Ouchida, MLD (w/o)

State of California
California Environmental Protection Agency
AIR RESOURCES BOARD

Protocol for the Application and Ambient Air Monitoring of Malathion and Malaoxon In Imperial County During Winter, 1998

Engineering and Laboratory Branch
Monitoring and Laboratory Division

Project No.
C98- 002 Ambient
C98-003 Application

Date: February 17, 1998

APPROVED:

Kevin Mongar, Project Engineer

Cynthia L. Castronovo, Manager
Testing Section

George Lew, Chief
Engineering and Laboratory Branch

This protocol has been reviewed by the staff of the California Air Resources Board and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Air Resources Board, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Protocol for the Application and Ambient
Air Monitoring of Malathion and Malaoxon
In Imperial County During Winter, 1998

I. Introduction

At the request of the California Department of Pesticide Regulation (DPR) (January 27, 1998 "Draft of Malathion Monitoring Recommendation"), the Air Resources Board (ARB) staff will determine airborne concentrations of the pesticide malathion in Imperial County over a three week ambient monitoring program during February and March of 1998. Application monitoring, conducted for 3 days at an application site, will also occur in Imperial County during either February or March, 1998. This monitoring will be done to fulfill the requirements of AB 1807/3219 (Food and Agricultural Code, Division 7, Chapter 3, Article 1.5) which requires the ARB "to document the level of airborne emissions .... of pesticides which may be determined to pose a present or potential hazard..." when requested by the DPR. Both the ambient and application monitoring programs are being conducted to coincide with the use of malathion as an insecticide on alfalfa.

The method development results and "Standard Operating Procedures for the Sampling and Analysis of Malathion and Malaoxon in Ambient Air" are not included in this report but will be finalized before monitoring begins.

II. Chemical Properties of Malathion

Malathion (CAS:121-75-5) exists as yellowish or dark-brown liquid. Technical formulations have a garlic-like odor and formulated products have a mercaptan-like odor. Malathion has a molecular formula of $C_{10}H_{19}O_6PS_2$, a formula weight of 330.36 g/mole, and a specific density of 1.23 at 25/4 °C. Malathion is miscible in alcohols, chloroform, DMSO, ketones, vegetable oils, and aromatic and alkylated aromatic hydrocarbons. It's solubility in water ranges from 140 - 165 mg/L (10-30 °C). Malathion has a Henry's Constant of 4.89×10^{-9} atm·m^3/mol at 25 °C, and a vapor pressure of 1.25×10^{-6} mm Hg at 20 °C. Malathion's photolysis half life is 51 hours (absorbance λ = 210 nm) on glass plates, but only 15 hours in Suwannee River (FL) water (pH 4.8, September). Physical/chemical properties for malaoxon are not available, although they are expected to be similar to those of malathion.

Malathion is transformed in all environmental compartments. In soil, malathion has been shown to degrade to malathion monoacid, malathion dicarboxylic acid, potassium dimethylphosphoro thioate, and potassium dimethylphosphorodithioate. In air, when exposed to Ultra Violet light, malathion decomposes to malathion monoacid, malathion diacid, O,O-diethyl phosphorothioic acid, dimethylphosphate and phosphoric acid. In water, malathion decomposes to a variety of compounds depending on pH, with reaction half-life inversely proportional to temperature.

Exposure limits for malathion are: ACGIH TLV: TWA 10 mg/m^3, NIOSH REL: 10 hour TWA 15 mg/m^3, and OSHA PEL: TWA 10 mg/m^3 (total dust) and 5 mg/m^3 (respirable fraction). Symptoms of exposure are excess salivation, headache, nausea, vomiting, abdominal cramps, diarrhea, ataxia, and lastly, death. Malathion is relatively non-toxic with an acute oral LD_{50} for

male and female rats of 2,800 mg/kg. Its LC_{50} (24 hour) is 100 ppb for rainbow trout, and 120 ppb for bluegill sunfish. Malathion entered the SB950 Risk Assessment process because of the potential human exposure during Mediterranean Fruit Fly eradication efforts, and because there was some concern of possible oncogenic effects.

III. Sampling

Samples will be collected by passing a measured volume of ambient air through XAD-2 resin tubes (SKC #226-30-06). The sampling flow rate of 3 Lpm will be accurately measured and the sampling system operated continuously with the exact operating interval noted. The resin tubes will be protected from direct sunlight and supported about 1.5 meters above the ground during application monitoring sampling periods and 1.5 meters above roof tops for the ambient monitoring. At the end of each sampling period, the tubes will be capped and placed in culture tubes with an identification label affixed. Subsequent to sampling, the sample tubes will be stored and transported in an ice chest on dry ice, as soon as reasonably possible, to the ARB Monitoring and Laboratory Division, Testing Section laboratory for analysis. The samples will be stored in the freezer or extracted and analyzed immediately.

A sketch of the sampling apparatus is shown in Figure 2. Calibrated rotameters will be used to set and measure sample flow rates. Samplers will be leak checked prior to and after each sampling period with the sampling cartridges installed. Any change in the flow rates will be recorded in the field log book. The field log book will also be used to record start and stop times, sample identifications and any other significant data.

Ambient Monitoring

The use patterns for malathion suggest that monitoring should occur in Imperial County during the months of February and March. Four sampling sites will be selected from the areas of Imperial County where alfalfa farming is predominant and in relatively high-population areas or in areas frequented by people with considerations for both accessibility and security of the sampling equipment. Background samples will be collected in an area distant to malathion applications. At each site, twelve discrete 24-hour samples will be taken during the sampling period. Replicate (collocated) samples will be collected for three dates (each Wednesday) at each sampling location.

The samples will be collected by ARB personnel over a three week period from (tentatively) February 23 - March 13, 1998. 24-hour samples will be taken Monday through Friday (4 samples/week) at a flow rate of 3 L/minute.

Application Monitoring

The use pattern for malathion suggests that application-site monitoring should be conducted during the months of February or March in Imperial County, and that the monitoring be associated with applications of malathion to alfalfa. A three day monitoring period will be established with desired sampling times as follows: Application + 1 hour, followed by one 2-hour sample, one 4-hour sample, two 8-hour samples, and two 24-hour samples. A minimum of four samplers will be positioned, one on each side of the field. A fifth sampler will be collocated at one position. Since malathion is extensively used in the area, background (before application)

samples should be collect for a minimum of 12 hours at 3 liters/min. Ideally, samplers should be placed at a minimum of 20 meters from the field. If possible the samplers will be spaced equidistant from the edges of the field.

We will also provide in the monitoring report: 1) An accurate record of the positions of the monitoring equipment with respect to the field, 2) an accurate drawing of the monitoring site showing the precise location of the meteorological equipment, trees, buildings, etc., 3) meteorological data collected at a minimum of 15 minute intervals including wind speed and direction, humidity, and comments regarding degree of cloud cover, 4) the elevation of each sampling station with respect to the field and 5) the orientation of the field with respect to North (identified as either true or magnetic north). Samples collected during fog episodes will be designated as such.

IV. Analysis

The method development results and "Standard Operating Procedures for the Sampling Analysis of Malathion and Malaoxon in Ambient Air"are not included in this protocol but will be finalized before monitoring begins. The procedures consist of extraction of the sorbent with 2.5 mL of ethyl acetate followed by GC/MSD analysis. The analytical method detection limits (MDL) for malathion and malaoxon are approximately 5.00 ng per sample and 25 ng per sample respectively. The practical quantitation limits (PQL) are approximately 25 ng per sample and 125 ng per sample respectively. The MDL calculation is: MDL=3.14(S) for n=7 and the PQL calculation is: PQL= 5 x MDL. The above PQL values correspond to approximately 0.43 pptv and 2.3 pptv for malathion and malaoxon respectively.

VI. Quality Assurance

Field Quality Control for the ambient monitoring will include:

1) Five field spikes (same environmental and experimental conditions as those occurring at the time of ambient sampling). The field spikes will be obtained by sampling ambient air at the background monitoring site for 24 hour periods at 3 L/minute (i.e., collocated with a background sample).

2) Five trip spikes prepared at the same level as the field spikes.

3) Five lab/freezer spikes prepared at the same level as the field and trip spikes.

4) Replicate samples will be taken for three dates at each sampling location.

5) A Trip blank will be obtained each week of sampling.

Field Quality Control for the a application monitoring will include:

1) Four field spikes (same environmental and experimental conditions as those occurring at the time of ambient sampling). The field spikes will be obtained by sampling ambient air during background monitoring at the application site for the same duration as the background samples at 3 L/minute (i.e., collocated with

0

background samples).

2) Four trip spikes prepared at the same level as the field spikes.

3) Four lab/freezer spikes prepared at the same level as the field and trip spikes.

4) Replicate samples will be taken for all samples at one of the sampling locations.

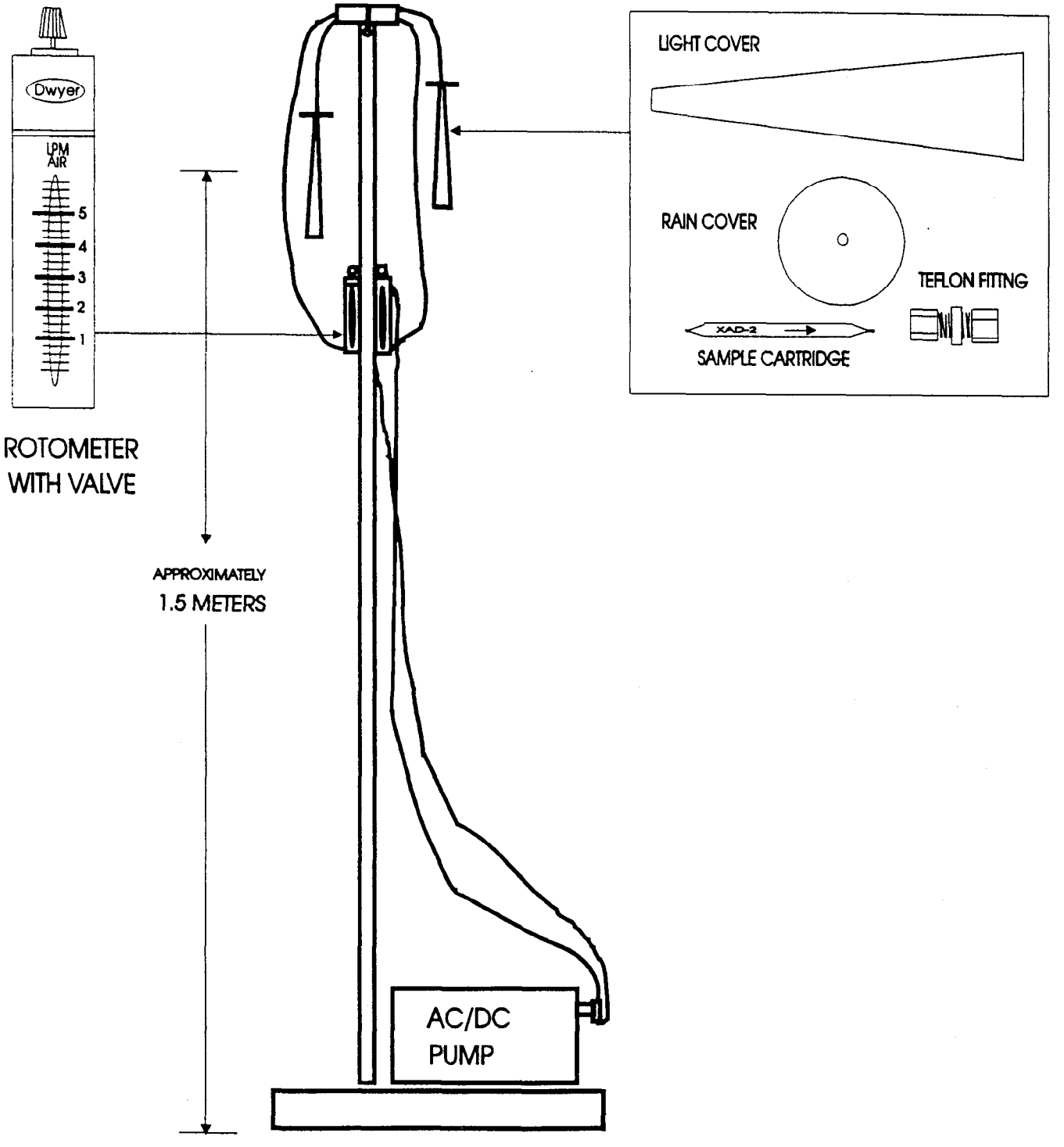
5) A Trip blank will be obtained.

The instrument dependent parameters (reproducibility, linearity and minimum detection limit) will be checked prior to analysis. A chain of custody sheet will accompany all samples. Rotameters will be calibrated prior to and after sampling in the field.

VII. Personnel

ARB personnel will consist of Kevin Mongar (Project Engineer) and an Instrument Technician and/or student assistants from either the Testing Section or the Air Monitoring Central Section of ARB.

FIGURE 1. SAMPLE TREE



APPENDIX II

LABORATORY REPORT

Air Resources Board

Barbara Riordan, Chairman

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ıston H. Hickox
Secretary for Environmental Protection

Gray Davis
Governor

MEMORANDUM

TO: Cindy Castronovo, Manager
Testing Section

FROM: Robert Okamoto
Lead Laboratory Chemist
Testing Section

DATE: January 27, 1999

SUBJECT: MALATHION AND MALAOXON MONITORING AND METHOD DEVELOPMENT RESULTS

Included in the attached report are the following items:

1. Ambient and application malathion and malaoxon analytical results.
2. Malathion standard operating procedure.
3. Quality assurance report.
4. Spike and blank results.
5. Background blank levels
   a. Chromatograms and extracted ion profiles.
   b. A malathion and malaoxon field spike total ion chromatogram.
   c. Extracted ion profile for malathion and malaoxon in a sample.
   d. Extracted ion profile for malathion and malaoxon at the estimated quantitation limit.
   e. Extracted ion profile for malathion and malaoxon in the resin blank.

Comment on sampling results:

Malaoxon was detected in many of the samples raising concerns as to whether the malaoxon is an artifact of sampling or representative of levels in the ambient air. To address this issue one needs to know how malaoxon is formed. When malathion is exposed to sunlight it is converted to the malaoxon. The ratio of malaoxon to malathion is higher in the ambient samples than in the application samples. This result may be explained by noting that the malathion residence time in the ambient air is longer than during an application. Thus, malathion in the ambient air has a longer time to be converted into the malaoxon. This suggests that malaoxon was formed in the atmosphere

and not during sampling. This is further supported by the field spike results that show good recoveries for the spiked malathion and malaoxon. If conversion of malathion occurred during sampling then malathion recoveries would be much lower and malaoxone recoveries would be much higher than expected. This was not observed where malathion recoveries ranged from 64%-97% and malaoxon recoveries ranged from 86%-128%.

State of California
California Environmental Protection Agency
Air Resources Board

Testing Section Laboratory Report

Malathion and Malaoxon Method Development and Malathion and Malaoxon Analytical Results for Ambient Monitoring Samples

Engineering and Laboratory Branch
Monitoring and Laboratory Division

Project No. C98-002 and C98-003
January 25, 1999

1.0 Introduction

The Air Resources Board (ARB) staff developed an air sampling and analysis method for malathion and malaoxon. Ambient air samples were collected and analyzed by ARB staff. This report covers malathion and malaoxon method development, malathion and malaoxon analytical results, and quality assurance results.

2.0 Method Development and Standard Operating Procedure.

In the fall of 1997 an isotope dilution malathion and malaoxon procedure was developed and validated. The standard operating procedure (SOP) also includes procedures that more closely match US Environmental Protection Agency methodology. The standard operating procedure is given in Attachment 1.

3.0 Ambient Sample Results.

3.1 Samples Received:

Ambient Samples
75 ambient samples
5 field spikes
5 trip spikes
5 laboratory spikes
3 trip blanks

Date Samples Received	Date Analysis Completed
3/02/98	7/28/98
3/09/98	3/25/98
3/17/98	8/24/98

All samples were extracted within 15 days of receipt.

Presented in Table 1 are the results of the analysis of the malathion and malaoxon ambient samples. Also included in Table 1 are the dates the laboratory received and analyzed the samples.

Table 1. Malathion and Malaoxon Ambient Results

Log ID	Sample Name	Date Received	Date Analyzed	Malathion Amount (ng/sample)	Malaoxon Amount (ng/sample)
1	HHS01	03/02/98	03/23/98	3.54E+1	<MDL[1]
2	PIN01	03/02/98	03/23/98	1.38E+2	3.84E+1
3	CAL01	03/02/98	03/23/98	8.77E+1	2.73E+3
4	BRA01	03/02/98	03/23/98	9.04E+1	Det
5	ARB01	03/02/98	03/23/98	Det[2]	<MDL
6	HHS02	03/02/98	03/23/98	Det	Det
7	PIN02	03/02/98	03/23/98	3.72E+1	Det
8	CAL02	03/02/98	03/23/98	3.17E+1	Det
9	BRA02	03/02/98	03/23/98	4.05E+1	<MDL
10	ARB02	03/02/98	03/23/98	<MDL	<MDL
11	HHS03	03/02/98	03/23/98	3.50E+1	Det
12	HHS03D	03/02/98	03/23/98	4.25E+1	6.06E+1
13	PIN03	03/02/98	03/23/98	8.91E+1	3.57E+1
14	PIN03D	03/02/98	03/23/98	1.39E+2	7.25E+1
15	CAL03	03/02/98	03/23/98	9.61E+1	Det
16	CAL03D	03/02/98	03/23/98	9.71E+1	<MDL
17	BRA03	03/02/98	03/23/98	5.13E+1	Det
18	BRA03D	03/02/98	03/23/98	5.45E+1	Det
19	ARB03	03/02/98	03/23/98	6.24E+1	6.25E+1
20	ARB03D	03/02/98	03/23/98	1.07E+2	7.66E+1
21	HHS04	03/02/98	03/23/98	6.77E+1*	5.68E+1*
22	PIN04	03/02/98	03/24/98	1.18E+2	7.35E+1
23	CAL04	03/02/98	03/24/98	3.87E+2	Det
24	BRA04	03/02/98	03/24/98	4.24E+1	4.15E+1
25	ARB04	03/02/98	03/24/98	3.08E+1	Det
26	TB4	03/02/98	03/24/98	<MDL	<MDL
27	TS1	03/02/98	03/25/98	6.20E+1	9.63E+1
28	TS2	03/02/98	03/25/98	6.24E+1	9.51E+1
29	TS3	03/02/98	03/25/98	6.10E+1	9.13E+1
30	TS4	03/02/98	03/25/98	1.37E+2	1.53E+2
31	TS5	03/02/98	03/25/98	1.50E+2	1.56E+2
32	HHS05	03/09/98	03/25/98	4.06E+1	Det
33	PIN05	03/09/98	03/25/98	1.34E+2	4.95E+1
34	CAL05	03/09/98	03/25/98	1.08E+2	6.07E+1
35	BRA05	03/09/98	03/25/98	2.97E+1	<MDL

Log ID	Sample Name	Date Received	Date Analyzed	Malathion Amount (ng/sample)	Malaoxon Amount (ng/sample)
36	ARB05	03/09/98	03/25/98	1.79E+1	<MDL
37	HHS06	03/09/98	03/25/98	5.47E+1*	4.48E+1*
38	PIN06	03/09/98	03/25/98	5.15E+1	6.29E+1
39	CAL06	03/09/98	03/25/98	7.76E+1	3.50E+1
40	BRA06	03/09/98	03/25/98	2.42E+1	4.01E+1
41	ARB06	03/09/98	03/25/98	1.95E+1	Det
42	HHS07	03/09/98	03/25/98	3.20E+1	Det
43	HHS07D	03/09/98	04/30/98	3.56E+1	Det
44	PIN07	03/09/98	03/25/98	9.75E+1	5.17E+1
45	PIN07D	03/09/98	04/30/98	9.81E+1	4.52E+1
46	CAL07	03/09/98	03/25/98	7.03E+1	3.77E+1
47	CAL07D	03/09/98	04/30/98	4.20E+1	Det
48	BRA07	03/09/98	03/25/98	2.29E+1	<MDL
49	BRA07D	03/09/98	04/30/98	2.09E+1	Det
50	ARB07	03/09/98	03/25/98	1.90E+1	Det
51	ARB07D	03/09/98	04/30/98	Det	Det
52	HHS08	03/09/98	04/30/98	2.63E+1	Det
53	PIN08	03/09/98	04/30/98	4.39E+1	3.58E+1
54	CAL08	03/09/98	04/30/98	6.13E+1	3.64E+1
55	BRA08	03/09/98	04/30/98	Det	Det
56	ARB08	03/09/98	04/30/98	Det	Det
56	ARB08	03/09/98	04/30/98	Det	Det
57	TB8	03/09/98	04/30/98	<MDL	<MDL
58	HHS09	03/17/98	04/30/98	Det	Det
59	PIN09	03/17/98	04/30/98	9.26E+1	4.89E+1
60	CAL09	03/17/98	04/30/98	Det	Det
61	BRA09	03/17/98	04/30/98	Det	Det
62	ARB09	03/17/98	04/30/98	2.38E+1	Det
63	HHS10	03/17/98	04/30/98	Det	Det
64	PIN10	03/17/98	04/30/98	1.57E+2	1.19E+2
65	CAL10	03/17/98	04/30/98	Det	Det
66	BRA10	03/17/98	04/30/98	Det	Det
67	ARB10	03/17/98	04/30/98	Det	Det
68	HHS11	03/17/98	04/30/98	1.73E+1**	<MDL*
69	HS11D	03/17/98	04/30/98	1.87E+1	Det
70	PIN11	03/17/98	04/30/98	6.54E+1	4.21E+1
71	PIN11D	03/17/98	04/30/98	7.62E+1	4.81E+1
72	CAL11	03/17/98	04/30/98	1.80E+1	Det

Log ID	Sample Name	Date Received	Date Analyzed	Malathion Amount (ng/sample)	Malaoxon Amount (ng/sample)
73	CAL11D	03/17/98	04/30/98	Det	Det
74	BRA11	03/17/98	04/30/98	1.98E+1	Det
75	BRA11D	03/17/98	04/30/98	1.85E+1	Det
76	ARB11	03/17/98	04/30/98	Det	Det
77	ARB11D	03/17/98	04/30/98	Det	Det
78	HHS12	03/17/98	8/25/98	7.29E+1	6.29E+1
79	PIN12	03/17/98	8/25/98	8.25E+1	4.83E+1
80	CAL12	03/17/98	8/25/98	4.89E+1	Det
81	BRA12	03/17/98	8/25/98	3.04E+1	Det
82	ARB12	03/17/98	8/25/98	3.11E+1	Det
83	TB12	03/17/98	8/25/98	<MDL	<MDL
	LS1	03/02/98	03/25/98	6.90E+1	7.95E+1
	LS2	03/02/98	03/25/98	6.72E+1	8.76E+1
	LS3	03/02/98	03/25/98	6.95E+1	8.83E+1
	LS4	03/02/98	03/25/98	7.02E+1	9.11E+1
	LS5	03/02/98	03/25/98	7.28E+1	1.07E+2
	FS1	03/02/98	03/25/98	6.47E+1	7.82E+1
	FS2	03/02/98	03/25/98	6.84E+1	9.20E+1
	FS3	03/02/98	03/25/98	7.28E+1	9.88E+1
	FS4	03/02/98	03/25/98	6.83E+1	8.42E+1
	FS5	03/02/98	03/25/98	6.82E+1	7.49E+1

*Average of two analyses

** Duplicate analyses were performed on HHS11 and one analytical result was above the EQL and the other analytical result was below the EQL. Only the result above the EQL is reported.

[1]<MDL= Sample amount below the method detection limit.

[2]Det = Sample amount between 2.72 ng/sample (MDL) and 13.6 ng/sample (EQL)

4.0 Malathion and Malaoxon Ambient Analytical Quality Control

Two laboratory control spikes and a laboratory control blank were prepped with each batch of samples. A laboratory solvent blank was run and a multi-point calibration was performed prior to the analysis of a sample set. Calibration check samples and duplicate sample analyses were run during the analysis of a sample set. Additional QC included field spikes, trip spikes, laboratory spikes, and trip blanks. A summary of the QC results is given in this section.

4.1 Mass spectrometer tune

The mass spectrometer was manually tuned prior to the analysis of each sample set. Tune parameters are given in the malathion and malaoxon SOP (Attachment 1).

4.2 Laboratory solvent blanks

A laboratory solvent blank was analyzed prior to the analysis of each sample set. Table 2 contains the results of the laboratory solvent blanks. No malathion and malaoxon is detected in any of the laboratory solvent blanks.

Table 2. Laboratory solvent blanks

Sample Name	Date	Malathion Amount (ng/sample)	Malaoxon Amount (ng/sample)
B980323	3/23/98	<MDL	<MDL*
B980324	3/24/98	<MDL	<MDL
B980430	4/30/98	<MDL	<MDL
B980824	8/24/98	<MDL	<MDL

*<MDL = blank level below the method detection limit

4.3 Calibration

A 5-point multi-point calibration was run prior to the analysis of each sample set.

4.4 Laboratory control spikes

Two laboratory control spikes (LCS) were run prior to the analysis of each batch of samples. A sample batch is defined as all the samples that are prepped during the same time period. A LCS is a resin cartridge spiked with 250 ngs of malathion and malaoxon. The control sample is prepared and analyzed the same way as the samples. Malathion LCS recoveries ranged from 93.3%-113% and the relative difference between samples in each set ranged from 1.41% -

3.08%. Malaoxon LCS recoveries ranged from 78.7%-136% and the relative difference between samples in each set ranged from 0.940%-3.29%. The results are presented in Table 3.

Table 3. Laboratory control spike results.

Sample Name	Date Analyzed	Malathion Amount (ng/sample)	Percent Recovery	Malaoxon Amount (ng/sample)	Percent Recovery
LC11	3/23/98	270	108%	265	106%
LC12	3/23/98	259	104%	283	113%
LC11	3/24/98	243	97.1%	317	127%
LC12	3/24/98	258	103%	340	136%*
LC23	4/30/98	273	109%	292	117%
LC24	4/30/98	283	113%	309	124%
LC23	8/24/98	233	93.3%	197	78.7%
LC24	8/24/98	245	97.8%	217	86.9%

*Recovery greater than 130%

4.5 Laboratory control blanks

A single laboratory control blank (LCB) is run prior to the analysis of each sample batch. The LCB blank sample cartridge is prepared and analyzed the same way as the samples are analyzed. The LCB results are presented in Table 4. <MDL means the level in the blanks were lower than the detection level.

Table 4. Laboratory control blank results

Sample Name	Date Analyzed	Malathion Amount (ng/sample)	Malaoxon Amount (ng/sample)
LB06	3/23/98	<MDL*	<MDL
LB06	3/24/98	<MDL	<MDL
LB11	4/30/98	<MDL	<MDL
LB11	8/24/98	<MDL	<MDL

*<MDL = Amount below the method detection limit

4.6 Calibration check samples

Calibration check samples (CCS) are analyzed with each set of samples. A CCS is run after every tenth sample in a sample set. CCS samples ensure instrument drift does not exceed 25%. CCS sample results are given in Table 5. The average CCS percent recovery for malathion and malaoxon was 95.7% and 106% respectively. The relative standard deviation for malathion and malaoxon is 7.27%and 7.86% respectively.

Table 5. Malathion calibration check sample results

Sample Name	Date Run	Malathion Amount (ng/sample)	Malathion Expected (ng/sample)	Percent Recovery
CC032303	03/24/98	93.0	100	93.0%
CC032302	03/24/98	97.5	100	97.5%
CC032301	03/24/98	100.0	100	100%
CC032304	03/24/98	91.4	100	91.4%
CC032401	03/25/98	96.3	100	96.3%
CC032402	03/25/98	96.5	100	96.5%
CC032403	03/25/98	100.2	100	100%
CC032404	03/25/98	104.5	100	104%
CC043001	04/30/98	95.5	100	95.5%
CC043002	04/30/98	91.8	100	91.8%
CC043003	04/30/98	97.2	100	97.2%
CC043004	04/30/98	104.0	100	104%
CC04301A	04/30/98	96.5	100	96.5%
CC072802	08/25/98	75.8	100	75.8%

Table 5 (cont.). Malaoxon calibration check sample results.

Sample Name	Date Run	Malaoxon Amount (ng/sample)	Malaoxon Expected (ng/sample)	Percent Recovery
CC032303	03/24/98	99.5	100	99.5%
CC032302	03/24/98	114	100	114%
CC032301	03/24/98	100	100	100%
CC032304	03/24/98	97.9	100	97.9%
CC032401	03/25/98	108	100	108%
CC032402	03/25/98	104	100	104%
CC032403	03/25/98	110	100	110%
CC032404	03/25/98	111	100	111%
CC043001	04/30/98	111	100	111%
CC043002	04/30/98	110	100	110%
CC043003	04/30/98	114	100	114%
CC043004	04/30/98	110	100	111%
CC04301A	04/30/98	111	100	111%
CC072802	08/25/98	84.2	100	84.2%

4.7 Duplicate analysis

Duplicate analysis is performed on every tenth sample in a sample analysis set. Results are given in Table 6. Relative difference was calculated on duplicate pairs when the values were at or higher than the EQL. The malathion relative difference range from 3.48% -5.06% and the malaoxon relative difference range from 3.56%-10.9%.

Table 6. Duplicate malathion analysis results

Sample Name	Malathion Amount (ng/sample)	Average (ng/sample)	Relative Difference
HHS04-1	6.88E+1		
HHS04-2	6.65E+1	6.77E+1	3.48%
HHS06-1	5.61E+1		
HHS06-2	5.34E+1	5.47E+1	5.06%
ARB08-1	Det[1]		
ARB08-2	Det	NQ[2]	NC[3]
HHS11-1	1.73E+1		
HHS11-2	Det	NQ	NC

[1]Det=Level below the estimated quantitation limit
[2]NQ=not quantitated
[3]NC=not calculated
Relative Difference = 100*(analysis1-analysis2)/average

Table 6 (cont.) Malaoxon duplicate analysis results

Sample Name	Malaoxon Amount (ng/sample)	Average (ng/sample)	Relative Difference
HHS04-1	5.79E+1		
HHS04-2	5.58E+1	5.68E+1	3.56%
HHS06-1	4.73E+1		
HHS06-2	4.24E+1	4.48E+1	10.9%
ARB08-1	Det[1]		
ARB08-2	Det	NQ[2]	NC[3]
HHS11-1	<MDL[4]		
HHS11-2	<MDL	NQ	NC

[1]Det=Level below the estimated quantitation limit
[2]NQ=not quantitated
[3]NC=not calculated
[4]<MDL = Value below method detection limit
Relative Difference = 100*(analysis1-analysis2)/average

5.0 Field, trip, and laboratory spikes and trip blanks

Five laboratory spikes, five trip spikes and five field spikes were analyzed for the ambient malathion and malaoxon test.

5.1 Laboratory spikes

On 2/19/98 five laboratory spikes were spiked with 75 ngs of malathion and malaoxon. The laboratory spikes were stored in the Testing's Laboratory freezer until they were analyzed on 3/24/98. The laboratory spike results are given in Table 7. The average percent recovery for malathion is 93.0% and the relative standard deviation is 2.92%. The average percent recovery for malaoxon is 121% and the relative standard deviation is 11.1%.

Table 7. Laboratory spikes results

Sample Name	Date Spiked	Date Analyzed	Malathion Amount (ng/sample)	Percent Recovery	Malaoxon Amount (ng/sample)	Percent Recovery
LS01	2/19/98	3/24/98	69.0	92%	79.5	106%
LS02	2/19/98	3/24/98	67.2	90%	87.6	117%
LS03	2/19/98	3/24/98	69.5	93%	88.3	118%
LS04	2/19/98	3/24/98	70.2	94%	91.1	121%
LS05	2/19/98	3/24/98	72.8	97%	107	143%*

*Recovery of malaoxon exceeded 130%

5.2 Trip spikes

A series of 5 trip spikes were spiked with 75.0 ngs of malathion and malaoxon on 2/19/98. Trip spikes were taken to the sampling site and returned to laboratory along with a batch of samples, which were analyzed on 3/25/98. The trip spike results are given in Table 8. The malathion average recovery is 91.3% and the relative standard deviation is 4.20%. The malaoxon average recovery is 114% and the relative standard deviation is 11.5%.

Table 8. Trip spike results

Sample Name	Date Spiked	Date Analyzed	Malathion Amount (ng/sample)	Percent Recovery	Malaoxon Amount (ng/sample)	Percent Recovery
FS01	2/19/98	3/24/98	64.7	86.3%	78.2	104%
FS02	2/19/98	3/24/98	68.4	91.2%	92.0	123%
FS03	2/19/98	3/24/98	72.8	97.1%	98.8	132%*
FS04	2/19/98	3/24/98	68.3	91.1%	84.2	112%
FS05	2/19/98	3/24/98	68.2	90.9%	74.9	100%

*Recovery of malaoxon exceeded 130%

5.3 Field spikes

A series of 5 field spikes were spiked with 75 ngs of malathion and malaoxon on 2/19/98. Field spikes were taken to the sampling site and ambient air was sampled on the field spikes. An unspiked colocated sample was taken concurrently with the field spikes. The field spikes were returned to the laboratory along with a batch of samples. The field spike results are given in Table 9. The malathion average recovery of the field spikes is 92.7% with a relative standard deviation of 16.6%. The malaoxon average recovery of the field spikes is 124% with a relative standard deviation of 2.63%.

Table 9. Malathion Field spike results

Sample Name	Colocated blank	Date Analyzed	Malathion Amount in Sample (ng/sample)	Amount Malathion in blank (ng/sample)	Percent Recovery
TS01	ARB02	3/24/98	62.0	<MDL*	86%
TS02	ARB02	3/24/98	62.4	<MDL	91%
TS03	ARB02	3/24/98	61.0	<MDL	97%
TS04	ARB03	3/24/98	137	62.4	91%
TS05	ARB03	3/24/98	150	62.4	91%

Table 9 (cont.) Malaoxon Field Spike Results

Sample Name	Colocated blank	Date Analyzed	Malaoxon Amount in sample (ng/sample)	Amount Malaoxon in blank (ng/sample)	Percent Recovery
TS01	ARB02	3/24/98	96.3	<MDL	128%
TS02	ARB02	3/24/98	95.1	<MDL	127%
TS03	ARB02	3/24/98	91.3	<MDL	122%
TS04	ARB03	3/24/98	153	62.5	121%
TS05	ARB03	3/24/98	156	62.5	125%

*<MDL = less than the method detection limit

5.4 Trip blanks

Three trip blanks were taken to the sampling site and returned to the laboratory with a batch of samples. The trip blank results are given in Table 10.

Table 10. Trip blank results

Sample Name	Date Analyzed	Malathion Amount in Sample (ng/sample)	Malaoxon Amount in Sample (ng/sample)
TB08	4/30/98	<MDL*	<MDL
TB08	4/30/98	<MDL	<MDL
TB12	8/25/98	<MDL	<MDL

*<MDL=less than the method detection limit

6.0 Application Sample Results.

6.1 Samples Received:

Application Samples
39 application samples
4 field spikes
4 trip spikes
4 laboratory spikes
1 trip blank

Date Samples Received	Date Analysis Completed
3/09/98	7/30/98

All samples were extracted within 15 days of receipt.

Presented in Table 11 are the results of the analysis of the malathion and malaoxon ambient samples. Also included in Table 11 are the dates the laboratory received and analyzed the samples. An asterisk to the right of the malathion and malaoxon amount denotes the sample was analyzed in duplicate and the results are the average of the two analyses.

Table 1.Malathion Application Results

Log ID	Sample Name	Date Received	Date Analyzed	Malathion Amount (ng/sample)	Malaoxon Amount (ng/sample)
1	SB	03/02/98	03/04/98	3.86E+1	Det[1]
2	SFS4	03/02/98	03/04/98	9.68E+1	8.72E+1
3	WB	03/02/98	03/04/98	3.89E+1	Det
4	WFS1	03/02/98	03/04/98	9.12E+1	8.28E+1
5	NB	03/02/98	03/04/98	4.46E+1	Det
6	NFS2	03/02/98	03/04/98	9.81E+1	8.63E+1
7	EB	03/02/98	03/04/98	4.31E+1	Det
8	EFS3	03/02/98	03/04/98	9.10E+1	7.83E+1
9	N1	03/02/98	03/04/98	1.48E+1	<MDL[2]
10	W1	03/02/98	03/04/98	8.40E+2*	<MDL*
11	S1	03/02/98	03/04/98	2.79E+2	<MDL
12	E1	03/02/98	03/04/98	2.77E+2	<MDL
13	E1D	03/02/98	03/04/98	5.13E+1	<MDL
14	N2	03/02/98	03/04/98	Det	<MDL
15	W2	03/02/98	03/04/98	9.26E+2	<MDL
16	S2	03/02/98	03/04/98	9.43E+2	<MDL
17	E2	03/02/98	03/04/98	6.18E+2	<MDL
18	E2D	03/02/98	03/04/98	4.77E+2	<MDL
19	N3	03/02/98	03/04/98	2.59E+2	<MDL
20	W3	03/02/98	03/04/98	6.88E+1	<MDL
21	S3	03/02/98	03/04/98	3.13E+2*	<MDL*
22	E3	03/02/98	03/04/98	3.87E+2	<MDL
23	E3D	03/02/98	03/04/98	5.45E+2	<MDL
24	N4	03/02/98	03/04/98	3.14E+2	<MDL
25	W4	03/02/98	03/04/98	7.98E+2	Det
26	S4	03/02/98	03/04/98	3.46E+2	3.43E+1
27	E4	03/02/98	03/04/98	5.50E+2	Det
28	E4D	03/02/98	03/04/98	5.39E+2	3.57E+1
29	N5	03/02/98	03/04/98	7.33E+2	4.05E+1
30	W5	03/02/98	03/04/98	1.20E+3	1.36E+2
31	S5	03/02/98	03/04/98	9.66E+2*	5.77E+1*
32	E5	03/02/98	03/25/98	3.68E+2	1.53E+2
33	E5D	03/02/98	03/25/98	8.67E+2	4.78E+1
34	N6	03/02/98	03/25/98	1.05E+3	8.30E+1
35	W6	03/02/98	07/30/98	6.84E+3	2.58E+2

Log ID	Sample Name	Date Received	Date Analyzed	Malathion Amount (ng/sample)	Malaoxon Amount (ng/sample)
36	S6	03/02/98	07/30/98	2.61E+3	2.60E+2
37	E6	03/02/98	07/30/98	3.52E+3	2.61E+2
38	E6D	03/02/98	07/30/98	3.28E+3	2.21E+2
39	N7	03/02/98	03/25/98	7.47E+2	Det
40	W7	03/02/98	07/30/98	5.72E+3	2.10E+2
41	S7	03/02/98	03/25/98	1.30E+3	1.42E+2
42	E7	03/02/98	03/25/98	1.50E+3	1.23E+2
43	E7D	03/02/98	03/25/98	1.36E+3	8.65E+1
44	TS1	03/02/98	03/25/98	5.86E+1	6.94E+1
45	TS2	03/02/98	03/25/98	6.09E+1	7.13E+1
46	TS3	03/02/98	03/25/98	5.42E+1	6.53E+1
47	TS4	03/02/98	03/25/98	6.00E+1	Coel[3]
48	TB	03/02/98	03/25/98	<MDL	<MDL
	LS1	03/02/98	03/25/98	5.42E+1	4.01E+1
	LS2	03/02/98	03/25/98	5.74E+1	7.04E+1
	LS3	03/02/98	03/25/98	5.76E+1	6.88E+1
	LS4	03/02/98	03/25/98	9.75E+1	7.38E+1

*Average of two analyses

[1]Det = Sample amount between the 2.72 ng/sample (MDL) and 13.6 ng/sample (EQL)

[2]<MDL= Sample amount below the method detection limit.

[3]Coel = Interfering compound coeluted with malaoxon and sample was not quantitated.

7.0 Malathion and Malaoxon Ambient Analytical Quality Control

Two laboratory control spikes and a laboratory control blank were prepped with each batch of samples. A laboratory solvent blank was run and a multi-point calibration was performed prior to the analysis of a sample set. Calibration check samples and duplicate sample analyses were performed during the analysis of a sample set. Additional QC included field spikes, trip spikes, laboratory spikes, and trip blanks. A summary of the QC results is given in this section.

7.1 Mass spectrometer tune

The mass spectrometer was manually tuned prior to the analysis of a sample set. Tune parameters are given in the malathion and malaoxon SOP (Attachment 1).

7.2 Laboratory solvent blanks

A laboratory solvent blank was analyzed prior to the analysis of each sample set. Table 12 presents the results of the laboratory solvent blanks for the two analytical sample sets. No malathion and malaoxon was detected in any of the laboratory solvent blanks

Table 12. Laboratory solvent blanks

Sample Name	Date	Malathion Amount (ng/sample)	Malaoxon Amount (ng/sample)
Blk-1	3/04/98	<MDL	<MDL*
Blk-2	7/30/98	<MDL	<MDL

*MDL = Amount below the method detection level.

7.3 Calibration.

A 5-point multi-point calibration was run prior to each analysis set.

7.4 Laboratory control spikes

Two laboratory control spikes (LCS) were run prior to the analysis of each batch of samples. A LCS is a resin cartridge spiked with 250 ngs of malathion and malaoxon. The control sample is prepared and analyzed the same way as the samples. LCS recoveries for malathion range from 86.0%-98.1% and the relative difference between the LC13/LC14 pair is 3.63% and the relative difference between the LC11/LC12 pair is 1.04%. LCS recoveries for malaoxon range from 108-115% and the relative difference between the LC13/LC14 pair is 3.59% and the relative difference between the LC11/LC12 pair is 4.44%. The results are presented in Table 13.

Table 13. Laboratory control spike results.

Sample Name	Date Analyzed	Malathion Amount (ng/sample)	Percent Recovery	Malaoxon Amount (ng/sample)	Percent Recovery
LC13	3/4/98	237	94.6	270	108%
LC14	3/4/98	245	98.1	280	112%
LC11	7/20/98	217	86.9%	288	115%
LC12	7/20/98	215	86.0%	277	110%

Relative Difference = 100*(sample1-sample2)/average

7.5 Laboratory control blanks

A single laboratory control blank (LCB) was run with each batch of samples. The LCB blank sample cartridge is prepared and the same way the samples are prepared. The LCB results are presented in Table 14. <MDL means the level in the blanks were lower than the detection level.

Table 14. Laboratory control blank results

Sample Name	Date Analyzed	Malathion Amount (ng/sample)	Malaoxon Amount (ng/sample)
LB07	3/04/98	<MDL	<MDL
LB08	7/29/98	<MDL	<MDL

*<MDL = Amount below the method detection limit

7.6 Calibration check samples

Calibration check samples (CCS) were analyzed with each analytical sample set. A CCS was run after every tenth sample in a set of samples. CCS samples ensure instrument drift did not exceed 25%. CCS sample results are given in Table 15. The average CCS percent recovery for malathion and malaoxon are 84.5% and 90.0% respectively. The relative standard deviation for malathion and malaoxon are 5.60% and 16.4% respectively.

Table 15. Malathion calibration check sample results

Sample Name	Date Run	Malathion Amount (ng/ml)	Malathion Expected (ng/ml)	Percent Recovery
CC030301	3/04/98	83.7	100	83.7%
CC030302	3/05/98	87.2	100	87.2%
CC030303	3/05/98	80.1	100	80.1%
CC030303A	3/05/98	90.4	100	90.4%
CC030304	3/05/98	84.1	100	84.1%
CC030305	3/06/98	83.5	100	83.5%
CC072801	7/30/98	82.0	100	82.0%
CC072802	7/30/98	77.5	100	77.5%
CC072804	7/30/98	92.3	100	92.3%

Table 15 (cont.) Malaoxon Calibration Check Sample Results

Sample Name	Date Run	Malaoxon Amount (ng/ml)	Malaoxon Expected (ng/ml)	Percent Recovery
CC030301	3/04/98	82.9	100	82.9%
CC030302	3/05/98	79.2	100	79.2%
CC030303	3/05/98	80.3	100	80.3%
CC030303A	3/05/98	78.6	100	78.6%
CC030304	3/05/98	82.7	100	82.7%
CC030305	3/06/98	85.9	100	85.9%
CC072801	7/30/98	100	100	100%
CC072802	7/30/98	96.0	100	96.0%
CC072804	7/30/98	124	100	124%

7.7 Duplicate analysis

Duplicate analysis was performed on every tenth sample in a set of samples analyzed. Results are given in Table 16. Relative difference was calculated on duplicate pairs when the values were at or higher than the EQL. The malathion relative difference range from 2.26%-4.92%. The malaoxon relative difference is 12.2%.

Table 16. Malathion duplicate analysis results

Sample Name	Malathion Amount (ng/sample)	Average (ng/sample)	Relative Difference
W1-1	8.51E+2		
W1-2	8.10E+2	8.31E+2	4.92%
S3-1	8.68E+1		
S3-2	8.66E+1	3.12E+2	2.26%
S5-1	9.87E+1		
S5-2	9.44E+1	9.66E+1	4.44%

[1]<MDL=level below the method detection level
[2]Det=Level below the estimated quantitation limit
[3]NQ=not quantitated
[4]NC=not calculated
Relative Difference = 100*(Analysis1-Analysis2)/average

Table 16 (cont.). Malaoxon duplicate analysis results

Sample Name	Maloxone Amount (ng/sample)	Average (ng/sample)	Relative Difference
W1-1	<MDL[1]		
W1-2	<MDL	NQ[2]	NC[3]
S3-1	<MDL		
S3-2	<MDL	NQ	NC
S5-1	6.13E+1		
S5-2	5.42E+1	5.77E+1	12.2%

[1]<MDL=level below the method detection level
[2]NQ=not quantitated
[3]NC=not calculated
Relative Difference = 100*(Analysis1-Analysis2)/average

8.0 Field, trip, and laboratory spikes and trip blanks

Four laboratory spikes, four trip spikes and four field spikes were analyzed for the application test.

8.1 Laboratory spikes

Four laboratory spikes were spiked on 2/19/98 with 75 ngs of malathion and malaoxon and stored in the Testing's Laboratory freezer until they were analyzed on 3/25/98. The laboratory spike results are given in Table 17. The average malathion percent recovery is 75.9% and the average malaoxon percent recovery is 94.2%. A coeluting compound with malaoxon prevented the quantitation of maloxone in sample LS04.

Table 17. Laboratory spikes results

Sample Name	Date Spiked	Date Analyzed	Malathion Amount (ng/sample)	Percent Recovery	Malaoxon Amount (ng/sample)	Percent Recovery
LS01	2/19/98	3/25/98	54.2	72.2%	Coel*	
LS02	2/19/98	3/25/98	57.4	76.6%	70.3	93.7%
LS03	2/19/98	3/25/98	57.6	76.8%	68.8	91.7%
LS04	2/19/98	3/25/98	58.6	77.9%	73.8	97.1%

*Coel = coeluting compound prevented quantitation.

8.2 Trip spikes

A series of 4 trip spikes were spiked with 75 ngs of malathion and malaoxon on 2/19/98. Trip spikes were taken to the sampling site and returned to laboratory along with a batch of samples, which were analyzed on 3/25/98. The trip spike results are given in Table 18. The average recovery is 77.9% and 91.6% for malathion and malaoxon respectively.

Table 18. Trip spike results

Sample Name	Date Spiked	Date Analyzed	Malathion Amount (ng/sample)	Percent Recovery	Malaoxon Amount (ng/sample)	Percent Recovery
TS01	2/19/98	3/25/98	58.6	78.1%	69.4	92.5%
TS02	2/19/98	3/25/98	60.9	81.2%	71.3	95.1%
TS03	2/19/98	3/25/98	54.2	72.3%	65.3	87.1%
TS04	2/19/98	3/25/98	60.0	80.0%	Coel*	

*Coel = Coeluting compound prevented quantitation

8.3 Field spikes

A series of 4 field spikes were spiked with 75 ngs of malathion and maloxone on 2/19/98. Field spikes were taken to the sampling site and ambient air was sampled on the field spikes. An unspiked colocated sample was taken concurrently with each field spike. The field spike was returned to the laboratory along with a batch of samples. The field spike results are given in Table 19. The average recovery of the field spikes is 70.7% for malathion. Malaoxon recoveries could not be calculated since the level in the colocated blank was between the EQL and the MDL. A range of recoveries was calculated by subtracting EQL and the MDL from the amount in the spike. The recoveries range from 86%-113%.

Table 19. Malathion field spike results

Sample Name	Colocated blank	Date Analyzed	Malathion Amount (ng/sample)	Amount Malathion in Blank (ng/sample)	Percent Recovery
SFS04	S01	3/25/98	96.6	38.6	78%
WFS01	W01	3/25/98	91.2	38.8	70%
NFS02	N01	3/25/98	98.1	44.6	71%
EFS03	E01	3/25/98	91.0	43.1	64%

Table 19(cont.) Malaoxon Field Spike Results

Sample Name	Colocated blank	Date Analyzed	Malaoxon Amount (ng/sample)	Amount Malaoxon in Blank (ng/sample)	Percent Recovery
SFS04	S01	3/25/98	116	>2.7-<13.5	98-113%*
WFS01	W01	3/25/98	110	>2.7-<13.5	92-107%
NFS02	N01	3/25/98	115	>2.7-<13.5	100-111%
EFS03	E01	3/25/98	104	>2.7-<13.5	86-100%

*Recoveries range is given since the amount in the colocated blank is between the method detection limit and the estimated quantitation limit.

8.4 Trip blanks

One trip blank was taken to the sampling site and returned to the laboratory with a batch of samples. The trip blank result is given in Table 20.

Table 20. Trip blank results

Sample Name	Date Analyzed	Amount in Sample (ng/sample)
TB	5/19/98	<MDL

*<MDL=less than the method detection limit

9.0 Sample Stability

All samples were extracted within 16 days which is within the 344 day time limit that the spiked resin samples were shown to be stable.

Sample extracts were analyzed within 150 days of extraction. To determine if sample extracts are stable for that period of time four-laboratory control spike extracts were analyzed at various intervals up to 150 days after extraction. The results are given in Table 21. All of the control spike recoveries were between 70-130% except for malaoxon analyzed on 3/24/98. This suggests that malaoxon and malaoxon are quite stable in extract form. Because the control sample extracts were stable over a 150 day time period, all extracts analyzed within the same time period were considered stable and the results reported.

Table 21. Extract Stability.

Sample Name	Date Analyzed	Malathion Amount (ng/sample)	Percent Recovery	Malaoxon Amount (ng/sample)	Percent Recovery
LC11	3/23/98	270	108%	265	106%
LC11	3/24/98	243	97.1%	317	127%
LC11	7/20/98	217	86.9%	288	115%
LC11	7/29/98	234	93.4%	321	128%
LC12	3/23/98	259	104%	283	113%
LC12	3/24/98	258	103%	340	136%*
LC12	7/20/98	215	86.0%	277	110%
LC12	7/29/98	283	90.8	315	112%
LC23	4/30/98	272.5	109%	292	116.6
LC23	8/24/98	233.3	93.3%	197	78.7%
LC24	4/30/98	283.2	113%	309	124%
LC24	8/24/98	244.6	97.8%	217	86.9%

*result exceeded 130% recovery.

10.0 Backup resin analysis.

The backup resin beds of five samples with the highest malathion and malaoxon levels were analyzed for breakthrough. Malathion was detected in all the backup beds. The percent malathion in the back tube ranged from 0.47% to 1.3% of the malathion measured in the main tube. No malaoxon was detected in any of the backup resin beds. The results are given in Table 22.

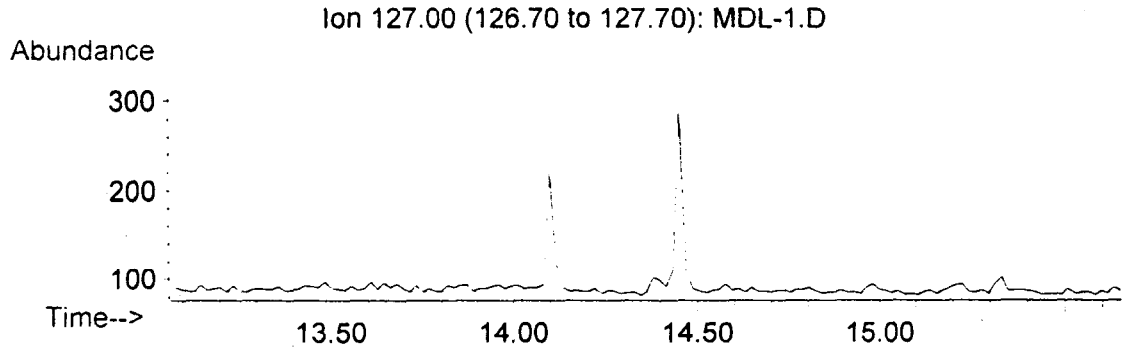
Table 22. Blank resin results

Sample Name	Malathion Amount (ng/sample)	Malaoxon Amount (ng/sample)
E6	28.6	<MDL
E6D	41.6	<MDL
W6	59.0	<MDL
S6	24.3	<MDL
W7	26.7	<MDL

*<MDL = Level in sample below the method detection limit

11. Malathion and Malaoxon Chromatograms and Extracted Ion Profiles

Figure 1. Extracted ion profiles (EIC) of a malathion and malaoxon standard at 10 pg/ul. The malaoxon peak at 14.10 minutes is shown in EIC profile of m/e of 127. The malathion peak at 14.45 minutes is shown in EIC profile of m/e of 173.



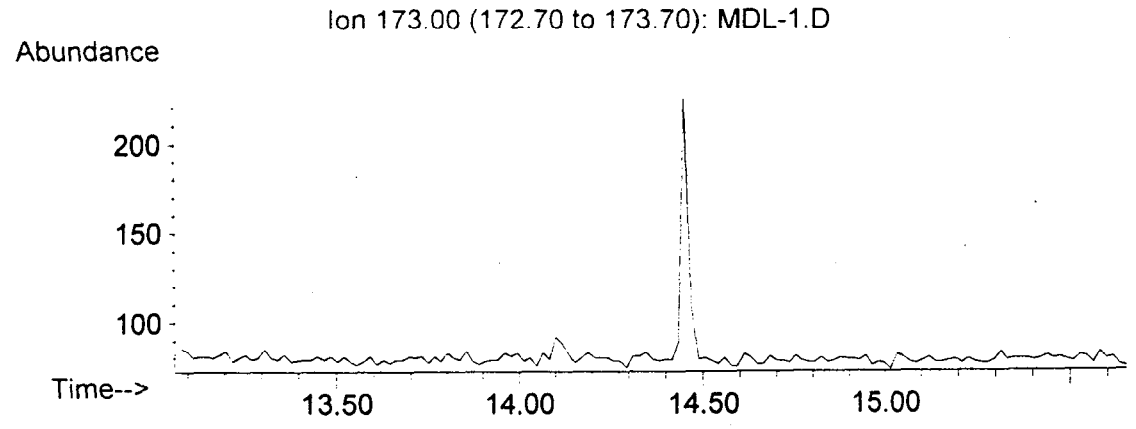


Figure 2. Total ion chromatogram of ambient field spike sample TS01 spiked with malathion and malaoxon at 75 ng/sample. The retention time for malathion is 14.31 and for malaoxon is 13.98 minutes.

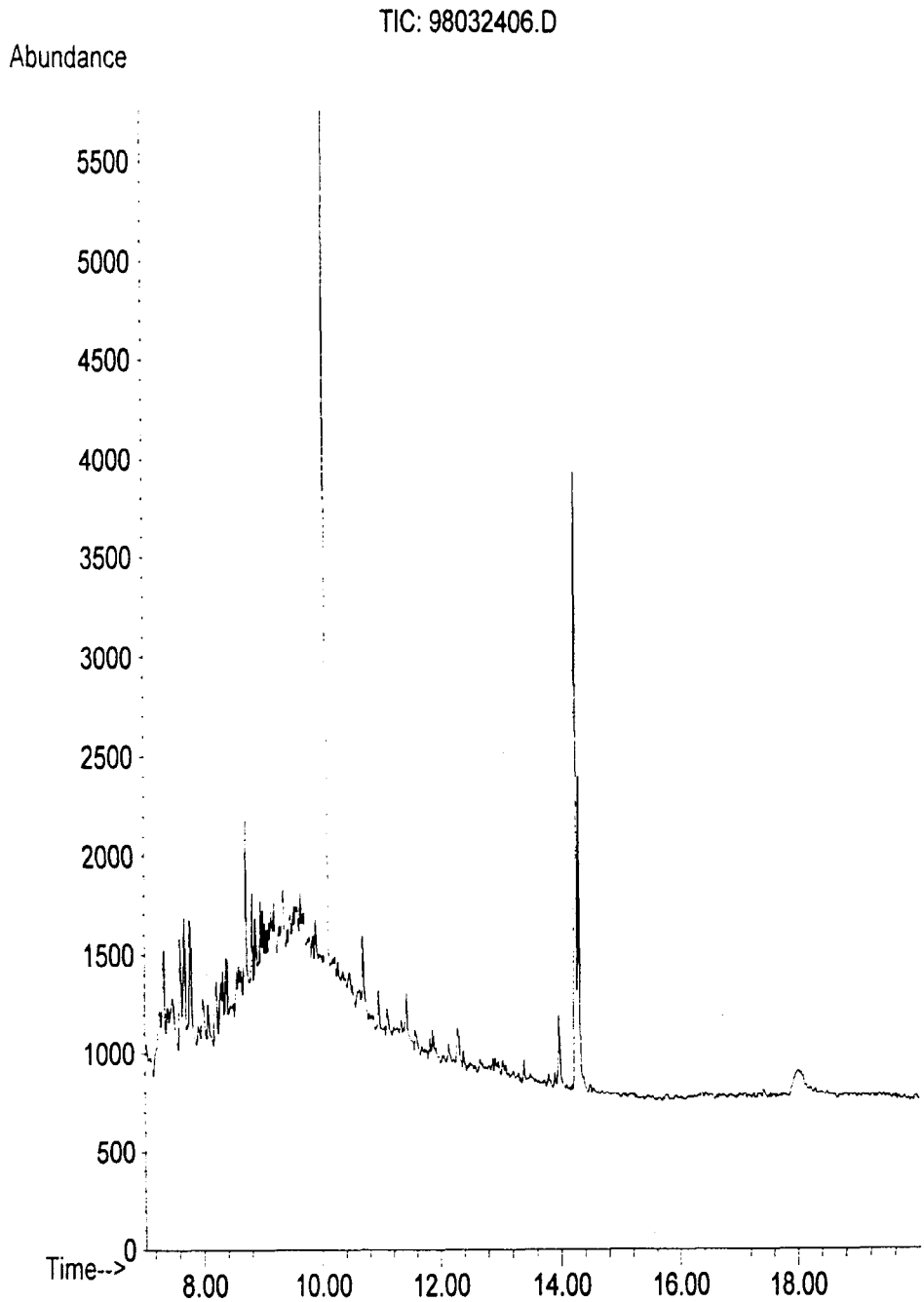


Figure 3. XAD resin blank extracted ion profiles. Extracted ion profiles for malathion quantitation ion 173, malathion-d_{10} 183 and malaoxon quantitation ion 127 are shown in Figure 3. No malathion or malaoxon was detected..

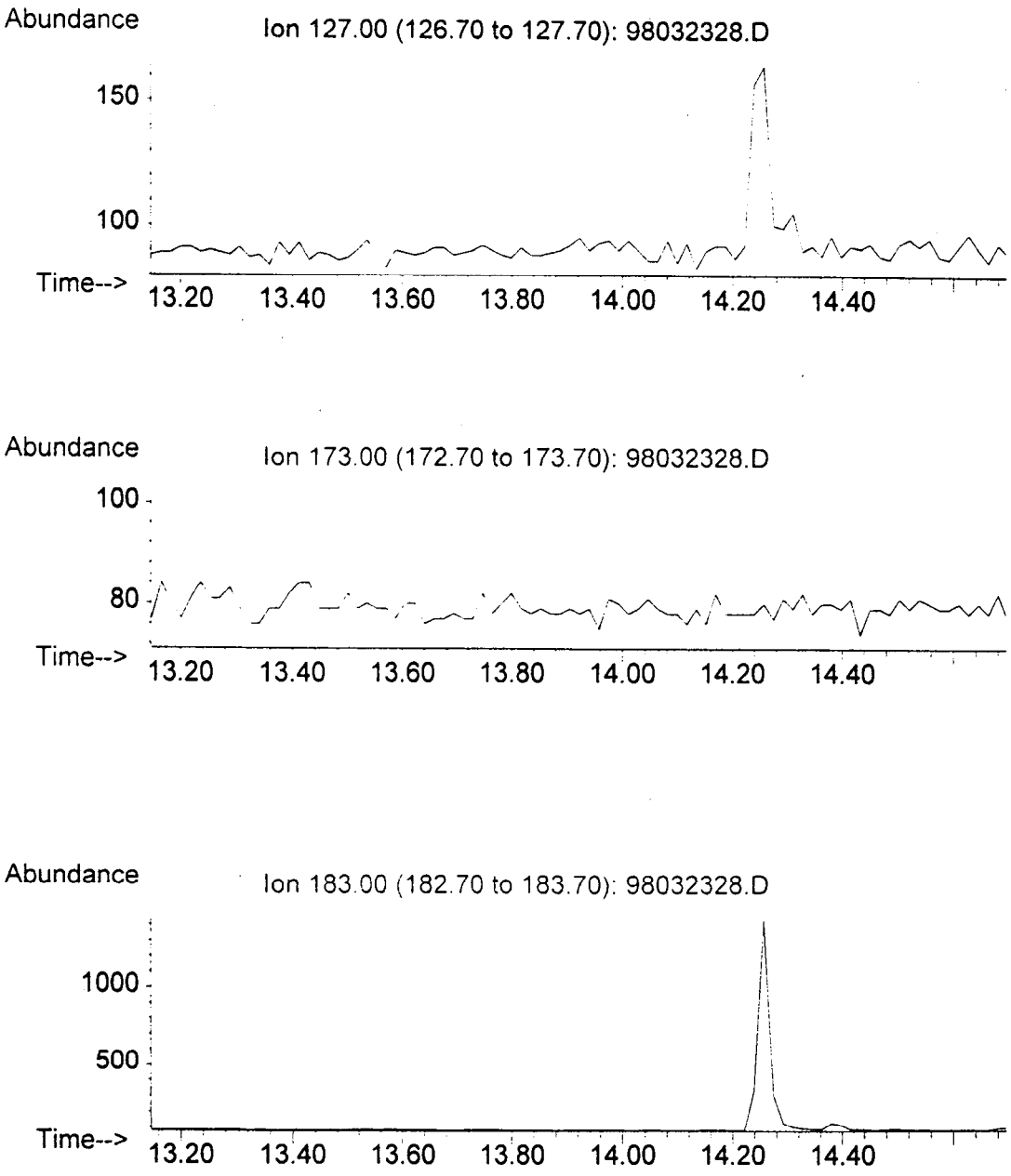
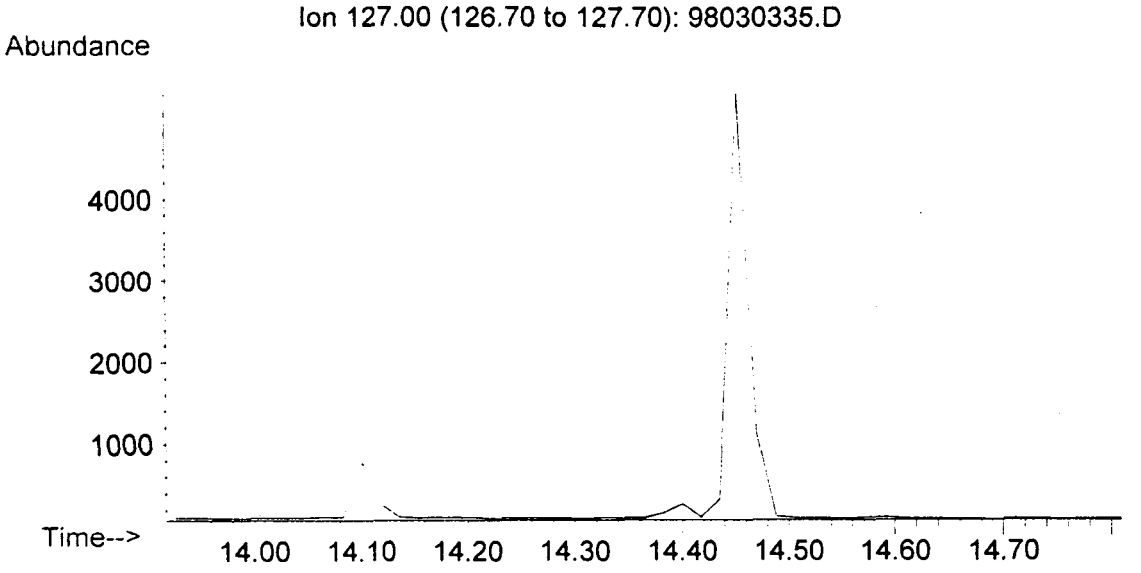
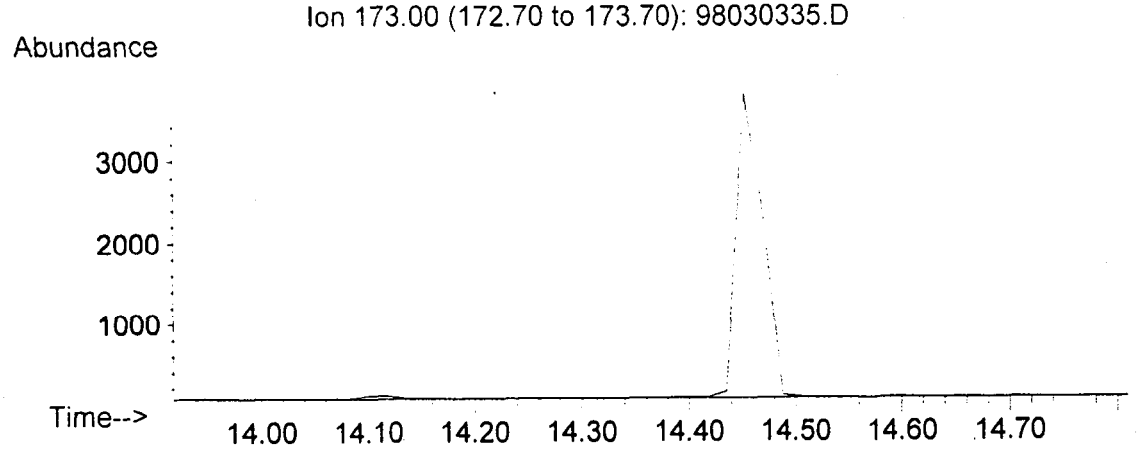


Figure 4. Shown below is application sample E5 EICs for m/e of 173 and 127. Peak at 14.10 min. in EIC 127 is malaoxon and peak at 14.45 min. in EIC 173 is malathion .





Attachment 1
Malathion and Malaoxon SOP

State of California
Air Resources Board
Monitoring and Laboratory Division/ELB

Standard Operating Procedure for the Sampling and Analysis of
Malathion in Ambient Air
01/25/99Version

Analyst: Ken Kiefer and R. Okamoto
Reviewed by: R. Okamoto
Kevin Mongar

1. SCOPE

This is a sorbent tube, solvent extraction, gas chromatography/mass spectrometry method for the determination of malathion and its oxidation product malaoxon from ambient air samples.

2. SUMMARY OF METHOD

The exposed XAD-2 resin tubes (SKC #226-30-06) are stored in an ice chest on dry ice or freezer until desorbed during sonication into 2.5 ml of ethyl acetate. The sorbent is spiked with 250ng of malathion-D_6 prior to extraction. The splitless injection volume is 4 ul. A gas chromatograph with a DB-17 capillary column and a quadrapole mass spectrometer (MS) is used for analysis. The MS detector is operated in selected ion monitoring mode.

3. INTERFERENCES/LIMITATIONS

Method interferences may be caused by contaminants in solvents, reagents, glassware and other processing apparatus that can lead to discrete artifacts or elevated baselines. Co-eluting compounds trapped during sample collection may also interfere. A method blank must be analyzed with each batch of samples to detect any possible method interferences.

4. EQUIPMENT AND CONDITIONS

A. INSTRUMENTATION:

Hewlett Packard 5890 chromatograph
Hewlett Packard 5971A mass selective detector
Hewlett Packard 8200 autosampler

Detector: 280°C
Injector: 250°C
Injector Liner: Double goose neck liner with glass wool or double cyclo gooseneck liner

Column: J&W Scientific DB-17MS, 30 meter, 0.25 mm i.d., 0.25 um film thickness.

Pre-column: J&W Scientific deactivated fused silica, 2 meter, 0.25 mm i.d.

GC Temp. Program: Initial 50°C, hold 5 min., to 220°C @ 25°C/min., hold 2 min., to 280°C @ 5°C/min., hold 1 min.
Injector:

Pressure Pulse: Initial 6.4 psi, to 40 psi @ 99 psi/min, hold 1.31 min, to 6.4 psi @ 99 psi/min
Splitless: Purge on 2 min.
Gas Flows:
Column: Linear velocity: 32 cm/sec, electronic pressure control (6.4 psi @ 50 °C).

Auto Sampler:

Sample washes - 1, Sample pumps - 4, Sample Volume - 5 stops, Viscosity delay - Zero sec, Solvent A washes - 4, Solvent B washes - 4

Mass Spectrometer:

Electron Ionization Mode.
Selective Ion Monitoring; Malathion -173 (quant. ion, 100%), 125 (qual. ion, 110%), 126 (qual. ion, 105%), 158 (qual. Ion, 50%). Malaoxon-127 (quant. Ion, 100%), 99 (qual. Ion, 30%), 263 (qual. Ion, 10%), 195 (qual. Ion, 20%). Malathion-D_8 - 183 (quant. ion, 100%), 125 (qual. ion, 140%), 158 (qual. Ion, 60%).
Tuning: PFTBA

B. AUXILIARY APPARATUS:

1. Glass amber vials, 8 mL capacity.
2. Glass amber vials, 4 mL capacity.
3. Vial Shaker, SKC, or equiv.
4. Sonicator, Branson 2210
5. Autosampler vials with septum caps.

C. REAGENTS

1. Ethyl Acetate, Pesticide Grade, or better
2. Malathion, 99.5 -% pure or better (e.g., from Chem Service).
3. Malaoxon, 95%-pure (e.g., from Chem Service).
4. Malathion-D_8 99, -% pure or better (e.g., from Cambridge Isotope Laboratories)

5. ANALYSIS OF SAMPLES

1. A daily manual tune shall be performed using PFTBA. The instrument is tuned using masses - 69, 219, 502. The criterion for the peak widths at 1/2 the peak height is 0.5. The criteria for relative abundances are; 69:100%; 219:60-70%; and 502:2-5%.

2. It is necessary to analyze a solvent blank with each batch of samples. The blank must be free of interferences. A solvent blank must be analyzed after any sample, which results in possible carry-over contamination.

3. A 5-point calibration curve shall be analyzed with each batch of samples.

4. A laboratory blank and two laboratory control spike samples will be run with each batch of samples. A laboratory control blank is a blank resin cartridge prepared and analyzed the same way the samples are analyzed. A laboratory control spike is a resin cartridge spiked with a known amount of standard. The check sample is prepped and analyzed the same way as the samples. Laboratory control spikes need to be within 20% (100*difference/average) of each other and have recoveries that are +/-30% of the theoretical spiked value.

   At least one calibration check sample must be analyzed for each set of samples analyzed. The response of the standard must be within 25% of the initial calibration analyses for the batch. If the calibration check is outside the limit then those samples in the set after the last calibration check that was within the 25% limit need to be reanalyzed.

6. Carefully score the secondary section end of the sampled XAD-2 tube above the glasswool and break at the score. Remove the glass wool plug from the secondary end of the XAD-2 tube with forceps and place it into a 4 mL amber colored sample vial. Pour the backup portion of the XAD-2 into the same vial. Spike the back end of the primary XAD with 12.5 ul of 20 ng/ml malathion-D_{10}. Let the solvent evaporate for approximately 10 minutes. Remove the middle glass wool plug and store in the 4 mls amber vial. Retain the secondary section of the XAD-2 tube for later analysis if needed to check the possibility of breakthrough

7. Carefully score the secondary section end of the sampled XAD-2 tube above the glasswool and break at the score. Remove the glass wool plug from the secondary end of the XAD-2 tube with forceps and place it into a 4 mL amber colored sample vial. Pour the backup portion of the XAD-2 into the same vial.

8 Pour the primary XAD into a 8 ml vial. Remove the glasswool plug and put it into the 8 ml vial. Rinse the tube with 2.5 ml of ethyl acetate and pour rinse into the 8 ml vial.

9. Place the sample vial on a desorption shaker (or ultra sonic water-bath) for 30 minutes. Remove the extract and store in a second vial at -20°C until analysis.

10. After calibration of the GC system, inject 5.0 ul of the extract. If the resultant peak for either malathion or malaoxon has a measured concentration greater than that of the highest standard injected dilute the sample and re-inject.

11. Calculate the concentration in ng/mL based on the data system calibration response factors. If the sample has been diluted, multiply the calculated concentration by the dilution factor.

12. The atmospheric concentration is calculated according to:

    Conc., ng/m^3 = (Extract Conc., ng/mL X 2.5 mL) / Air Volume Sampled, m^3

6. QUALITY ASSURANCE

A. INSTRUMENT REPRODUCIBILITY

Five injections of 4 ul each were made of malathion and malaoxon standards at three concentrations in order to establish the reproducibility of this instrument. This data (Testing Section lab, 12/11/97) is shown in Table 1.

TABLE 1. Instrument Reproducibility

Malathion -D8 Conc. (ng/ml)	Malathion -D8 Response	Malathion Conc. (ng/ml)	Malathion Response	Amt. Ratio	Resp Ratio	Response Ratio RSD
100	1653	12.5	248	.125	.212	
100	1763	12.5	281	.125	.228	
100	1853	12.5	269	.125	.226	
100	1869	12.5	247	.125	.250	
100	1706	12.5	261	.125	.228	5.92
100	2036	50	1085	.50	.976	
100	2144	50	1205	.50	1.03	
100	1945	50	1175	.50	1.03	
100	1961	50	1093	.50	1.05	
100	2040	50	1126	.50	1.08	3.84
100	2452	200	6084	2.0	5.49	
100	2527	200	6147	2.0	5.87	
100	2413	200	6050	2.0	5.96	
100	2521	200	6000	2.0	5.76	
100	2455	200	6296	2.0	5.73	3.06

Malathion -D8 Conc. (ng/ml)	Malathion -D8 Response	Malaoxon Conc. (ng/ml)	Malaoxon Response	Amt. Ratio	Resp Ratio	Response Ratio RSD
100	1653	12.5	128	.125	.212	
100	1763	12.5	186	.125	.228	
100	1853	12.5	197	.125	.226	
100	1869	12.5	135	.125	.250	
100	1706	12.5	149	.125	.228	5.92
100	2036	50	718	.50	.976	
100	2144	50	789	.50	1.03	
100	1945	50	710	.50	1.03	
100	1961	50	641	.50	1.05	
100	2040	50	669	.50	1.08	3.84
100	2452	200	3963	2.0	5.49	
100	2527	200	3892	2.0	5.87	
100	2413	200	3716	2.0	5.96	
100	2521	200	3677	2.0	5.76	
100	2455	200	4096	2.0	5.73	3.06

B. CALIBRATION

Linearity

Malaoxon

A linear regression was performed on a 12.5 pg/ul-200 pg/ul 5-point calibration curve made on 1/15/98.

Resp Ratio = (.650)*(amount ratio) – $1.37e^{-2}$

$R^2 = 1.00$

Malathion

A linear regression was performed on a 12.5 pg/ul-200 pg/ul 5-point calibration curve made on 1/15/98.

Resp Ratio = (1.16)*(amount ratio) – $2.63e^{-2}$

$R^2 = 0.999$

A laboratory check sample is run after every tenth sample in a batch to verify the system is still in calibration. Laboratory check samples must be within 20% of the assigned value. If the check sample is outside that range then the ten samples within that sample batch will be rerun.

C. MINIMUM DETECTION LIMIT

Detection limit is based on USEPA detection limit calculation. Using the analysis of seven replicates of low level matrix spikes, the method detection limit (MDL), and the estimated quantitation limit (EQL) for malathion and malaoxon were calculated by:

For malathion:

MDL = 3.14*s

EQL = 5*MDL

where:

s = the standard deviation of the concentration of the concentration calculated for the seven replicate spikes.

Given s =0.44 for the seven samples, the MDL and EQL are calculated as follows.

MDL = 3.14 *0.44 =1.39 pg/ul
EQL = 5 *1.39 = 6.93 pg/ul

Based on the 2.5 mL extraction volume and assuming a sample volume of 4.32 m^3 (3 lpm for 24 hours) the ambient concentration of malathion at the EQL is:

(6.93 ng/mL)(2.5 mL) / (4.32 m^3) = 4.01 ng/m^3 per 24-hour sample[1]

For malaoxon:

Given s = .87 for the seven samples, the MDL and EQL are calculated as follows.

MDL = 3.14 *.87 =2.72 pg/ul
EQL = 5 *2.72 = 13.6 pg/ul

Based on the 2.5 mL extraction volume and assuming a sample volume of 4.32 m^3 (3 lpm for 24 hours) the ambient concentration of malaoxon at the EQL is:

(13.6 ng/mL)(2.5 mL) / (4.32 m^3) =7.87 ng/m^3 per 24-hour sample

D. COLLECTION AND EXTRACTION EFFICIENCY (RECOVERY), STORAGE STABILITY AND BREAKTHROUGH.

Malathion and Malaoxon collection, extraction efficiency, and breakthrough were obtained from the malathion and malaoxon monitoring study.

Collection efficiency was determined from ambient and application field spikes. The average malathion collection efficiencies for the ambient and application spikes were 92.7% and 70.7% respectively. The average malaoxon collection efficiency for the ambient spikes was 124% and the application spikes ranged from 86-113%. Details of the collection efficiency results are given in Tables 9 and 19 of the malathion and malaoxon laboratory report.

Extraction efficiency was obtained from laboratory control spikes. The average recovery was 99.1% for malathion and 111% for malaoxon. The results are given in Tables 3 and 13 of the malathion and malaoxon laboratory report.

Three XAD resin tubes were spiked with 62.5 ngs of malathion and malaoxon on 2/10/98. The spikes were extracted on 1/14/99 and analyzed on 1/20/99. The malathion amounts recovered from the three spikes were 59.5 ngs, 60.4 ngs, 59.4 ngs with an average percent recovery of 95.6% and a relative standard deviation of 0.956%. The malaoxon amounts recovered from three spikes were 66.0 ngs, 59.1 ngs, and 53.4 ngs with an average percent recovery of 95.2 % with a relative standard deviation of 10.6%. The results indicate that the malathion and malaoxon are stable on resin cartridges for 344 days.

Breakthrough data was obtained from the monitoring study. Each sample consisted of a primary and backup bed of XAD2 resin. The backup bed from 5 samples containing the highest levels of malathion were analyzed to determine if breakthrough occurred. No breakthrough of malaoxon was observed. Malathion was observed to breakthrough in all five samples. Table 2 provides the amounts of malathion in the primary and secondary XAD bed as well the percent breakthrough to the second bed.

Table 2. Breakthrough of Malathion

Sample ID	Primary XAD Bed (ngs/sample)	Backup XAD Bed (ngs/sample)	% Breakthrough*
E6	3520	28.6	0.813
E6D	3280	41.6	1.27
W6	6840	59	0.863
S6	2610	24.3	0.931
W7	5720	26.7	0.467

*% Breakthrough is calculated as 100 x amount in the primary bed divided by the amount in the secondary bed.

E. Safety

Malathion is slightly toxic. The LD_{50} range from 480 mg/kg to10,700 mg/kg in the rat, and 775 mg/kg to greater than 3321 mg/kg for mice. The TLV is 15 mg/m^3. The RfD is 0.02 mg/kg/day.

APPENDIX III

PESTICIDE USE REPORT

COUNTY 13 X

STOKER COMPANY

339 WOOD RD IMPERIAL, CA. 92251 (619) 355-11

WORK ORDER

NOTICE OF INTENT TO APPLY RESTRICTED MATERIALS [X] AND / OR RECOMMENDATION [ ]

WORK ORDER ~~60899~~ 60899

GROWER	PERMIT	TIME	DATE
CARROLL F. NILSON CO	13-98-130597A	01:55 PM	02-21-9

LOCATION	SEC	TWN	RNG	MAP ID
SOUTH ALAMO 48	23	16S	15E	S

ACRES	CROP
50 ACRES	ALFALFA

APPLICATION INSTRUCTIONS: HOLD SAP CoW

AIR
METHOD: 5 GAL.
VOLUME PER ACRE: 250
TOTAL VOLUME:

SUPPLIER	INVOICE	JOB RECOMMENDATION	OTHER REFERENCE
DUNE CHEMICAL	401457 | 401458	1069	SAL48

PESTS: ALFALFA BLUE APHID, ALFALFA WEEVIL, ADJUVANT

RATE PER ACRE	CHEMICAL	TOTAL
~~1600 PT~~ 1.5 pt	~~BAYTHROID 2~~ Malathion 8 9½ gal	~~1 GAL~~
1.0100 PT	DIMETHOATE 267	6-1/4 GAL
.1400 PT	NU-FILM P	1-1/2 GAL
.1600 PT	10-12-0	1 GAL

FAXED 26 FEB 1998

COMPLETION

SPECIAL INSTRUCTIONS:

NOTIFY BEEKPRS 48 HRS BEFORE APPLICATION

REENTRY: XX
~~48~~ 12 (HRS) / DAYS
XXX AFTER DRIFT & VAPOR GONE
____ AFTER SPRAY DRIES
RESTRICTIONS:
10 DAYS TO HARVEST
10 DAYS TO PASTURE
DO NOT FEED OR GRAZE LIVESTOCK
ON ~~CROP~~ WASTE FOR ____ DAYS
____ AVOID DRIFT TO
XXX SURROUNDING AREAS
____ TOXIC TO BIRDS, BEES, FISH AND WILDLIFE

None
WRITTEN RECOMMENDATION HAS NOT BEEN MADE COVERING THE APPLICATION OF THE MATERIAL COVERED BY THIS WORK ORDER.

APPLICATOR	FILED	DATE	TIME
DAN DANIELS	X	2-21-98	1:55 PM

COMPLETED	TACH TIME	LOADS	TEMP	WIND
2-25 1350 AM/PM NIGHT	4	1	75-0	NW-3

LOT 1 CREW: TANKER: 50 FLAGGERS: 1 1 & 1 0051

COUNTY 13

STOKER COMPANY

339X WOOD RD. IMPERIAL, CA. 92251 (619) 355-11e

WORK ORDER

WORK ORDER 60900

NOTICE OF INTENT TO APPLY RESTRICTED MATERIALS [X] AND / OR RECOMMENDATION [ ]

GROWER: CARROLL F. NILSON CO	PERMIT: 13-98-130597A	TIME: 01:57 PM	DATE: 02-21-98	
LOCATION: SOUTH ALAMO 51	SEC: 23	TWN: 16S	RNG: 15E	MAP ID: S
ACRES: 140 ACRES	CROP: ALFALFA			

APPLICATION INSTRUCTIONS: ~~HOLD~~ SAP GW

METHOD: AIR
VOLUME PER ACRE: 5 GAL
TOTAL VOLUME: 700

SUPPLIER	INVOICE	JOB RECOMMENDATION	OTHER REFERENCE
DUNE CHEMICAL	4014571 4014581	1088	SALCI

PESTS: ALFALFA BLUE APHID, ALFALFA WEEVIL, ADJUVANT

RATE PER ACRE	CHEMICAL	TOTAL
~~.7143~~ 1.5pt	~~BAYTHROID E~~ malathion 8	2.6¼ gal ~~5 GAL~~
1.0095 PT	DIMETHOATE 267	17-5/8 GAL
.. o PT	NU-FILM P	4-1/4 GAL
.1143 PT	10-12-0	2 GAL

AXE 26 FEB 1998

COMPLETION

SPECIAL INSTRUCTIONS:

NOTIFY BEEKPRS 48 HRS BEFORE APPLICATION

REENTRY: XX
48 (HRS) / DAYS
XXX AFTER DRIFT & VAPOR GONE
____ AFTER SPRAY DRIES

RESTRICTIONS:
10 DAYS TO HARVEST
10 DAYS TO PASTURE
DO NOT FEED OR GRAZE LIVESTOCK ON CROP
XXX WASTE FOR ____ DAYS
____ AVOID DRIFT TO SURROUNDING AREAS
XXX
____ TOXIC TO BIRDS, BEES, FISH AND WILDLIFE

Jenna
[ ] WRITTEN RECOMMENDATION HAS NOT BEEN MADE COVERING THE APPLICATION OF THE MATERIAL COVERED BY THIS WORK ORDER.

DAN DANIELS	FILED: X	DATE: 02-21-98	TIME: 01:57 PM			
COMPLETED: 2-25	12:50 AM - PM - NIGHT	TACH TIME: 08	LOADS: 2	TEMP: 75°	WIND: NW-2	
LOT: L	CREW:	TANKER: RP	FLAGGERS: J. Fonseca	AIR 52		

APPENDIX IV

DPR's
AIR MONITORING RECOMMEDATIONS FOR MALATHION

FAX TRANSMISSION COVER SHEET

DEPARTMENT OF PESTICIDE REGULATION
ENVIRONMENTAL MONITORING AND PEST MANAGEMENT BRANCH
1020 N Street, Room 161
Sacramento, California 95814-5624
U.S.A.

IF THERE ARE ANY PROBLEMS WITH THIS TRANSMISSION
PLEASE CALL: (916) 324-4100
FAX: (916) 324-4088

TO: Cynthia Castronovo

FAX #: (916) 263-2067

NUMBER OF PAGES INCLUDING THE COVER SHEET: 9

FROM: Kevin Kelley

SUBJECT: Draft of Malathion Monitoring Recommendation

PHONE: 324-4187 E-MAIL ADDRESS: kkelley@cdpr.ca.gov

ORIGINAL IS BEING MAILED: ___ ORIGINAL IS NOT BEING MAILED: X

COMMENTS:

Values for the LOQ are not yet available. Will be included in final recommendation. We expect the LOQ's will be of similar magnitude of those for other pesticides. Final recommendation will also contain Use Figures for Imperial County.

DRAFT

California Department of Pesticide Regulation
Environmental Monitoring and Pest Management Branch

Staff Report

Use Information and Air Monitoring Recommendation for the Pesticide Active Ingredient Malathion and its Breakdown Product Malaoxon

January 1998

Principal Author

Kevin Kelley
Associate Environmental Research Scientist

State of California
Department of Pesticide Regulation
1020 N Street
Sacramento, California 95814-5624

DRAFT

USE INFORMATION AND AIR MONITORING RECOMMENDATION FOR THE PESTICIDE ACTIVE INGREDIENT MALATHION AND ITS BREAKDOWN PRODUCT MALAOXON

A. BACKGROUND

This recommendation contains general information regarding the physical-chemical properties, historical trends, and safety precautions for monitoring use of the insecticide *O,O*-Dimethyl-S-(1,2-dicarbethoxyethyl)dithiophosphate (Malathion) and it's breakdown product malaoxon. The Department of Pesticide Regulation (DPR) provides this information to assist the Air Resources Board (ARB) in their selection of appropriate locations for conducting pesticide air monitoring operations.

Malathion (CAS: 121-75-5) exists as yellowish or dark-brown liquid. Technical formulations have a garlic-like odor and formulated products have a mercaptan-like odor. Malathion has a molecular formula of $C_{10}H_{19}O_6PS_2$, a formula weight of 330.36 g/mole, and a specific density of 1.23 at 25/4 °C. Malathion is miscible in alcohols, chloroform, DMSO, ketones, vegetable oils, and aromatic and alkylated aromatic hydrocarbons. It's solubility in water ranges from 140 - 165 mg/L (10-30 °C). Malathion has a Henry's Constant of 4.89×10^{-9} atm · m³/mol at 25 °C, and a vapor pressure of 1.25×10^{-6} mm Hg at 20 °C. Malathion's photolysis half life is 51 hours (absorbance $\lambda = 210$ nm) on glass plates, but only 15 hours in Suwannee River (FL) water (pH 4.8, September). Physical/chemical properties for malaoxon are not available, although they are expected to be similar to those of malathion.

Malathion is transformed in all environmental compartments. In soil, malathion has been shown to degrade to malathion monoacid, malathion dicarboxylic acid, potassium dimethylphosphoro thioate, and potassium dimethylphosphorodithioate. In air, when exposed to Ultra Violet light, malathion decomposes to malathion monoacid, malathion diacid, *O,O*-diethyl phosphorothioic acid, dimethylphosphate and phosphoric acid. In water, malathion decomposes to a variety of compounds depending on pH, with reaction half-life inversely proportional to temperature.

Exposure limits for malathion are: ACGIH TLV: TWA 10 mg/m³, NIOSH REL:10 hour TWA 15 mg/m³; and OSHA PEL: TWA 10 mg/m³ (total dust) and 5 mg/m³ (respirable fraction). Symptoms of exposure are excess salivation, headache, nausea, vomiting, abdominal cramps, diarrhea, ataxia, and lastly, death. Malathion is relatively non-toxic with an acute oral LD_{50} for male and female rats of 2,800 mg/kg. Its LC_{50} (24 hour) is 100 ppb for rainbow trout, and 120 ppb for bluegill sunfish. Malathion entered the SB950 Risk Assessment process because of the potential human exposure during Mediterranean Fruit Fly eradication efforts, and because there was some concern of possible oncogenic effects.

B. USE OF MALATHION

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Malathion is an organophosphate insecticide widely used to control insects in both cropland and non-cropland situations, and for the control of mosquitoes in populated and rural areas. As of January 5, 1998, there were 57 malathion-containing products registered for use in California for the control of insect pests. The currently registered malathion-containing products include 23 products formulated for cropland or non-cropland insect control, 32 products formulated for use by individuals for the control of insects in and around homes, home gardens, and for crack and crevasse treatments in industrial/food processing areas. Two products are formulated for production of malathion-containing pesticide products. Agricultural products contain from 50% to 90% active ingredient (AI); the Signal-Word for these products (from product labels) is "Caution". Malathion-products formulated for home, home and garden, and industrial use contain from 2 % AI to 50 % AI, and also have the Signal-Word "Caution" on product labels. Malathion is formulated as emulsifiable and flowable concentrates, wettable powders, dusts, liquid sprays, aerosols, and oil solutions.

Malathion is not a restricted material; however, all commercial use must be reported to the county agricultural commissioner in the county where the product is applied. The agricultural commissioners forward this information (pounds of product applied, acreage, date, commodity, etc.) to DPR for compilation and publication in the annual Pesticide Use Report (PUR). Malathion-containing products formulated as home-use products are not restricted materials, and their uses are not recorded.

Malathion is used for the control of many insects in cropland situations, and application rates depend on insect species targeted, crop situation, and season of application. Malathion is a contact and stomach-poison, and applications are generally made under the following situations: 1) there is a notable presence of large specimens of the target insect; 2) there is noticeable feeding damage to plant foliage; and 3) foliage is dense and specimens of the target pest are present. For the control of lepidopterous insect pests of fruit and nut trees, product labels recommend malathion applications at petal fall and routinely thereafter, or it may be applied as a dormant spray. Malathion may be applied by fixed- and rotary-winged aircraft, by ground based thermal fog and air blast spray equipment (applications made above the plane of the horizon), and by ground based spray rigs (applications made below the plane of the horizon). Malathion may also be applied by chemigation, however only through field sprinkler systems.

For purposes of this monitoring recommendation, information on the cropland and non-cropland use of malathion was collected, and is presented in Table 1. Use of malathion in cropland situations accounts for approximately 80% of all reported applications. Use of malathion in non-cropland situations accounts for the remaining 20% of applications . Malathion use in cropland situations is reported on a township/range/section basis, unlike its use in non-cropland situations, where use is reported as total applications within the county. For these two reasons, this monitoring recommendation will be based solely on malathion use in cropland situations. When presented, historical use rates were calculated by dividing the total pounds of malathion applied (as reported in the PUR) by the acres to which it was applied.

Table 1. Annual Cropland and Non-Cropland Use of Malathion (Pounds Active Ingredient) for 1992-1995.

USE	1995	1994	1993	1992
Cropland	663,112	632,767	593,946	607,045
Non-Cropland	163,644	149,667	122,980	185,538
Total AI Applied	826,756	782,434	716,926	792,583
% Cropland Use	80.2%	80.9%	82.8%	76.6%
% Non-Cropland Use	19.8%	19.1%	17.2%	23.4%

According to the PUR, more than 90% of all the malathion applied in agricultural settings occurs in twenty counties (Table 2). Malathion is registered for use on a variety of agricultural crop plantings such as alfalfa, asparagus, berries (blueberry, cranberry, dewberry, raspberry, strawberry, etc.) corn, grapes, vegetables (beets, lettuce, spinach, curcubits), melons, legumes (peas, beans, lentils), rice and other grain crops, and on citrus, pomefruit, stonefruit and nut crop orchards. In annual agricultural plantings, malathion is generally applied via aircraft, ground-rig spray equipment, or via sprinkler irrigation. In permanent agricultural settings such as vineyards, orchards, and berry-producing croplands, malathion is generally applied via aircraft or thermal fog and air blast spray equipment. Most agricultural applications of malathion occur in Imperial County (30-40% total AI applied), and to a lesser yet significant extent in Monterey, Riverside, Tulare, and Santa Cruz counties.

In Imperial County, malathion is applied for insect control in a variety of cropland situations. Commodities treated include alfalfa, asparagus, cantaloupe, carrots, corn, cotton, lettuce, onion, peppers, sugarbeet, tomato, and watermelons. Application rates range from 0.9 lbs AI/acre to 3.5 lbs AI/acre. Malathion use (total lbs AI applied/day) begins to rise in January, peaks in February and March, and declines dramatically in April (Table 3, Figure 1). This peak in use coincides with malathion's application to alfalfa. A second, albeit smaller, peak occurs in September and October. Although some applications are made to alfalfa at this time, the bulk of malathion applications are made to leafy vegetables and sugarbeet crops.

From 1994 through 1996, eleven malathion-containing products were used on alfalfa in Imperial County. Currently, only five of these products remain active as of January 5, 1998. Product labels for these five products are included as Appendix A.

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Table 2. Annual Agricultural Use of Malathion for 1992-1995 (Pounds Active Ingredient)

County	1995	1994	1993	1992
Butte	4,546.81	7,395.48	6,946.07	12,210.67
Colusa	11,428.60	16,000.16	8,422.52	10,276.13
Fresno	14,448.30	13,107.21	22,556.94	24,547.33
Imperial	267,550.80	204,819.61	169,643.19	182,038.94
Kern	11,077.88	12,644.93	14,976.93	38,130.86
Kings	12,844.20	3,578.96	13,554.58	4,257.57
Madera	10,639.77	10,576.31	5,757.51	8,759.30
Merced	19,001.79	20,705.84	19,482.66	27,415.65
Monterey	75,526.47	114,425.67	77,026.04	65,095.40
Riverside	66,476.79	52,538.43	42,033.07	39,675.40
San Joaquin	13,474.88	14,275.39	10,660.84	15,334.55
Santa Barbara	17,592.56	13,481.11	16,950.95	12,002.98
Santa Cruz	22,594.88	33,372.57	32,148.79	31,259.52
Siskiyou	11,008.60	12,044.41	0	776.7
Stanislaus	6,676.7	9,780.27	50,506.24	8,759.30
Solano	7,533.27	3,631.61	9,004.70	11,614.74
Sutter	5,043.60	7,352.79	9,554.84	21,112.42
Tulare	24,540.51	14,277.23	12,638.55	22,216.76
Ventura	7,533.27	11,029.03	17,817.82	14,850.49
Yolo	7,317.05	12,495.54	11,493.45	12,580.95
County Totals	616,856.7	587,532.6	551,175.7	562,915.7
Percent of Total	93.0 %	92.9 %	92.8 %	92.7
CALIFORNIA TOTAL	663,112	632,767	593,946	607,045

Table 3. Use of Malathion in Imperial County For the Control of Alfalfa Pests

MONTH	1995		1994		1993		1992	
	lbs AI[1]	Rate[2]	lbs AI	Rate	lbs AI	Rate	lbs AI	Rate
January	17,645.2	1.41	4,757.8	1.35	3,600.6	1.59	0.0	
February	122,878.8	1.41	53,228.1	1.37	49,082.8	1.33	59,791.9	1.34
March	66,891.8	1.51	73,817.8	1.45	53,265.1	1.33	37,289.2	1.29
April	3,777.0	1.28	11,374.5	1.27	4,118.1	1.33	16,049.5	1.26

[1] In pounds of active ingredient.
[2] Average rate (in pounds of active ingredient per acre) for month of use.

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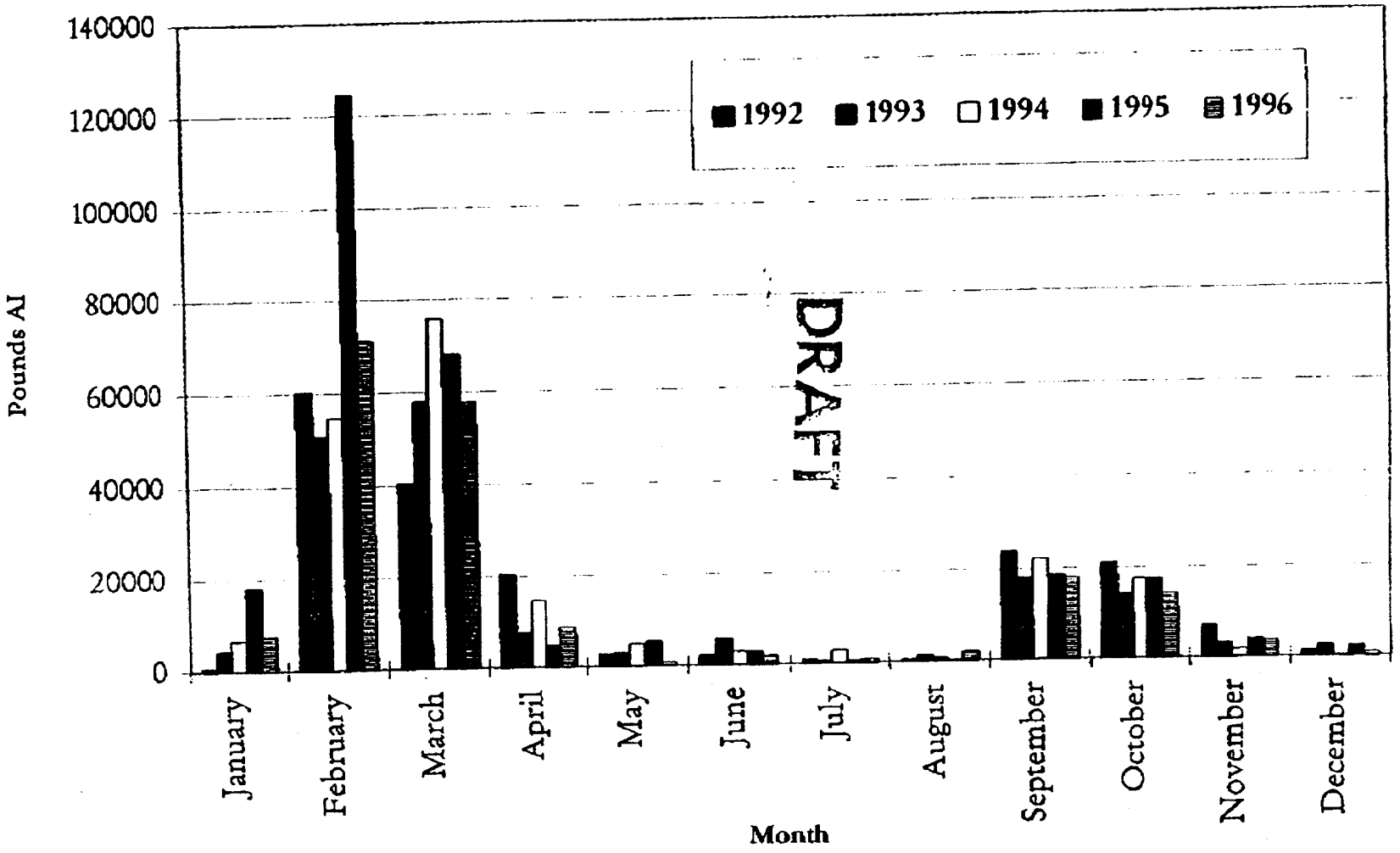
Figure 1. Malathion Use in Imperial County (1992 - 1996)



C. RECOMMENDATIONS

1. Ambient Air Monitoring

The historical trends in malathion use suggest that monitoring should occur over a 30- to 45-day sampling period in Imperial County from early February through late March, with the bulk of the sampling conducted during mid-February through mid-March (see Figure 1). Since applications to alfalfa accounts for approximately 95% of malathion applications during this time span, sampling sites should be located near alfalfa-growing areas (Figure 2). Three to five sampling sites should be selected in relatively high-population areas or in areas frequented by people. Ambient samples should not be collected from samplers immediately adjacent to fields or orchards where malathion is being applied (i.e. from public structures immediately (250 meters) surrounded by alfalfa or other fields to which malathion is applied.). At each site, fifteen to twenty discrete 24-hour samples should be taken during the sampling period. Background samples should be collected in an area distant to malathion applications. The Limit of Quantification for malathion and malaoxon are XXX ppt and YYY ppt, respectively.

Replicate (collocated) samples are needed for five dates at each sampling location. Two collocated samplers (in addition to the primary sampler) should be run on those days. The dates chosen for replicate samples should be distributed over the entire sampling period. They may, but need not be, the same dates at every site. Trip blank and field spike samples should be collected at the same environmental conditions (e.g., temperature, humidity, exposure to sunlight) and experimental conditions (e.g., air flow rates) as those occurring at the time of ambient sampling. Please also provide us with the location (Township/Range-Section) where monitors were located.

2. Application-Site Air Monitoring

The historical trends in malathion use (Table 4) suggest that application-site air monitoring should be conducted in Imperial County in areas associated with alfalfa (Figure 2). Application rates range from 0.5 to 3.5 lbs AI/acre during this time span; the median rate is 1.5 lbs AI/Acre. Therefore, we suggest that monitoring be conducted during February or March and that monitoring be associated with application rates of 1.5 lbs AI/acre (or more). Since large amounts of malathion are applied in Imperial County during these months, care should be taken to ensure that nearby applications do not contaminate collected samples. If other malathion applications occur nearby during application-site sample collection, please note the location(s) and amount(s) of these applications.

A three-day monitoring period should be established with sampling times as follows: application + 1 hour, followed by one 2-hour sample, one 4-hour sample, two 8-hour samples and two 24-hour samples. A minimum of five samplers should be positioned, one on each side of

the field, the fifth sampler should be collocated at one position. Background samplers should collect enough volume (either 12 hours at 15 liters/min, or a shorter period with a higher volume pump) to permit a reasonable minimum detection level. Ideally, samplers should be placed a minimum of 20 meters from the field, however, wherever samplers are placed, the distance from the field must be reported. Trip blanks and field spike samples should be collected at the same environmental conditions (temperature humidity, exposure to sunlight) and experimental conditions (similar air flow rates) as those occurring at the time of sampling.

Additionally, we request that you provide in the monitoring report: 1) an accurate record of the positions of the monitoring equipment with respect to the field, including the exact distance that the samplers are positioned from the field; 2) an accurate drawing of the monitoring site showing the precise location of the meteorological equipment, trees, buildings, and other obstacles; 3) meteorological data collected at a minimum of 15-minute intervals including wind speed and direction, humidity, air temperature, and comments regarding degree of cloud cover; and 4) the elevation of each sampling station with respect to the field, and the orientation of the field with respect to north (identified as either true or magnetic north).

D: Safety Considerations:

Malathion is a relatively non-toxic insecticide. However, care should still be taken during sample collection in the early stages of application-site monitoring. Most malathion products require a 12- to 24-hour re-entry interval between application and when workers may enter treated fields. For workers entering fields before the expiration of the re-entry interval, personal protective equipment is required to be worn. Malathion labels recommend the use of coveralls or long sleeved pants and shirt, shoes plus socks, and chemical-proof gloves for those workers who will be entering fields before the expiration of the re-entry interval, in which plants or water have been treated . Malathion products do not have buffer zones associated with any labeled uses. Monitoring personnel should refer to the label of the actual product used for further precautions.

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APPENDIX V

APPLICATION AND AMBIENT FIELD LOG SHEETS

LOG BOOK

Project: Malathion/Malaoxon Application in Imperial Co.

Project #: C98-003

Log #	Sample ID	Date	Time	Comments Rpt #	weather o = overcast pc = partly cloudy k = clear	taken by
1	MALSB	2/23 2/24	1955 1926	4A	K	KEM
2	SFS4	2/23 2/24	1955 1920	4B Field Spike		
3	WB	2/23 2/24	2000 1925	(green) 40		
4	WFS1	2/23 2/24	2000 1925	(red) 41		
5	NB	2/23 2/24	2010 1930	(top/bott red) 44		
6	NFS2	2/23 2/24	2010 1930	(top red) 45		
7	EB	2/23 2/24	2015 1935	(top) 42	partly overcast	
8	EFS3	2/23 2/24	2015 1935	(bottom) 43		
9	N1	2/25 2/25	1320 1520	several other aerial applications in the area. Field manager to the west of the site was treated at the same time. We were not aware that this was going to happen.	K	
10	N1	2/25 2/25	1320 1525			
11	S1	2/25 2/25	1320 1530			
12	E1	2/25 2/25	1320 1535			
13	E1B	2/25 2/25	1320 1535			
14	N2	2/25 2/25	1520 1725		K	
15	W2	2/25 2/25	1525 1735			
16	S2	2/25 2/25	1530 1740			
17	E2	2/25 2/25	1535 1745			
18	E2D	2/25 2/25	1535 1745			
19	N3	2/25 2/25	1~~85~~ 2125	1725		
20	W3	2/25 2/25	~~1835~~ 2130			
21	S3	2/25 2/25	1740 2145			
22	E3	2/25 2/25	1745 2140			
23	E3D	2/25 2/25	1745 2149			

bott. damage at 0900

partly overcast / scattered showers on 2/24/98

LOG BOOK

Project:Malathion/Malaoxon Application in Imperial Co.

Project #: C98-003

Log #	Sample ID	Date	Time	Comments	weather o = overcast pc = partly cloudy k = clear | taken by	
24	MAL-N4	2/25	2125		K	KEM
		2/26	0510			
25	W4	2/25	2130			
		2/26	0515			
26	S4	2/25	2135			
		2/26	0520			
27	E4	2/25	2140			
		2/26	0525			
28	E4D	2/25	2145			
		2/26	0525			
29	N5	2/26	0510			
		2/26	1220			
30	W5	2/26	0515			
		2/26	1230			
31	S5	2/26	0520			
		2/26	1235			
32	E5	2/26	2525			
		2/26	1240			
33	E5D	2/26	0525			
		2/26	1240			
34	N6	~~2/27~~	1220	2/25/98		
		~~2/28~~	1225	2/27/98		
35	W6	~~2/27~~	1230	"		
		~~2/28~~	1230			
36	S6	~~2/27~~	1235	"		
		~~2/28~~	1235			
37	E6	~~2/27~~	1240	"		
		~~2/28~~	1240			
38	E6D	~~2/27~~	1240	"		
		~~2/28~~	1240			
39	N7	2/28	1225	2/27/98		
		~~3/1~~	0955	2/28/98		
40	W7	2/28	1230			
		~~3/1~~	1000			
41	S7	2/28	1235			
		3/1	1005			
42	E7	2/28	1240			
		3/1	1010			
43	E7D	2/28	1240			
		3/1	1010			
44	TS1	3/1	1000	Trip Spike		
		3/1				
45	TS2	3/1	1000			
		3/1				

LOG BOOK

Project:Malathion/Malaoxon Application in Imperial Co.

Project #: C98-003

Log #	Sample ID	Date	Time	Comments	weather o = overcast pc = partly cloudy k = clear	taken by
46	TS3	3/1	1000			KEH
47	TS4	3/1	1000			↓
48	TB	3/1	1000	Trip Blank		
49						

LOG BOOK

Project: Malathion/Malaoxon Ambient in Imperial Co.
Project #: C98-002

Rain - P
Fog - F

Log #	Sample ID	Date	Time	Comments	weather o = overcast pc = partly cloudy k = clear	taken by
1	MAL-HHS1	02-23-98	0820			
		02-24-98	0820	11A	K	
2	" PIN1	02-23-98	0845			
		02-24-98	0845	12	K	
3	" CAL1	02-23-98	0925			
		02-24-98	0925	9A	K	
4	" BRA1	02-23-98	0950			
		02-24-98	0950	29	K	
5	" ARB1	02-23-98	1030			
		02-24-98	1030	10A	K	
6	" HHS2	02-24-98	0820			
		02-25-98	0820	11A	PC	
7	" PIN2	02-24-98	0845			
		02-25-98	0845	12	PC	
8	" CAL2	02-24-98	0925			
		02-25-98	0925	9A	PC	
9	" BRA2	02-24-98	0950			
		02-25-98	0950	29	PC	
10	" ARB2	02-24-98	1030			
		02-25-98	1030	10A	PC	
11	" HHS3	02-25-98	0820			
		02-26-98	0820	11A	K	
12	" HHS3D	02-25-98	0920			
		02-26-98	0920	11B	K	
13	" PIN3	02-25-98	0845			
		02-26-98	0845	12	K	
14	" PIN3D	02-25-98	0845			
		02-26-98	0845	13	K	
15	" CAL3	02-25-98	0925			
		02-26-98	0925	9A	K	
16	" CAL3D	02-25-98	0925			
		02-26-98	0925	9B	K	
17	" BRA3	02-25-98	0950			
		02-26-98	0950	29	K	
18	" BRA3D	02-25-98	0950			
		02-26-98	0950	28	K	
19	" ARB3	02-25-98	1030			
		02-26-98	1030	10A	K	
20	" ARB3D	02-25-98	1030			
		02-26-98	1030	8A	K	
21	" HHS4	02-26-98	0820			
		02-27-98	0820	11A	K	
22	" PIN4	02-26-98	0845			
		02-27-98	0845	12	K	

LOG BOOK

Project:Malathion/Malaoxon Ambient in Imperial Co.
Project #: C98-002

Log #	Sample ID	Date	Time	Comments	weather o = overcast pc = partly cloudy k = clear	taken by
23	MAL-CAL4	02-26-98 02-27-98	0925 0925	9A	K	
24	BRA4	02-26-98 02-27-98	0950 0950	29	K	
25	ARB4	02-26-98 02-27-98	1030 1030	10A	K	
26	TB 4	02-27-98	1030	Trip Blanks		
27	TS-1	02-24-98 02-25-98	1030 1030	10B	PC	
28	TS-2	02-24-98 02-25-98	1030 1030	8A	PC	
29	TS-3	02-24-98 02-25-98	1030 1030	8B	PC	
30	TS-4	02-25-98 02-26-98	1030 1030	10B	K	
31	TS-5	02-25-98 02-26-98	1030 1030	8B	K	

ARB-2

ARB3

* - Trip spikes were used as field spikes, I did not realize difference. FS 1-5 used as trip spikes.

Ted mis numbered the log #'s for this week. KEM reminded ted + also made changes to sample labels (and samples!)

LOG BOOK

Project: Malathion/Malaoxon Ambient in Imperial Co.
Project #: C98-002

	Log #	Sample ID	Date	Time	Comments	weather o = overcast pc = partly cloudy k = clear	taken by	
32	1	MAL-HHS X 5	03-02-98 / 03-03-98	0820 / 0820	11A	K		Ko
33	2	" -PIN X 5	03-02-98 / 03-03-98	0845 / 0845	12	K		Ko
34	3	" CAL X 5	03-02-98 / 03-03-98	0920 / 0920	9A	K		K
35	4	" BRA X 5	03-02-98 / 03-03-98	0945 / 0945	29	K		K
36	5	" ARB X 5	03-02-98 / 03-03-98	1030 / 1030	10A	K		K
37	6	" HH 2 6	03-03-98 / 03-04-98	0820 / 0820	11A	K		K
38	7	" PIN 2 6	03-03-98 / 03-04-98	0845 / 0845	12	K		K
39	8	" CAL 2 6	03-03-98 / 03-04-98	0920 / 0920	9A	K		K
40	9	" BRA 2 6	03-03-98 / 03-04-98	0945 / 0945	29	K		K
41	10	" ARB 2 6	03-03-98 / 03-04-98	1030 / 1030	10A	K		K
42	11	" HHS 3 7	03-04-98 / 03-05-98	0820 / 0820	11A	K		K
43	12	" HHS 3Q 10	03-04-98 / 03-05-98	0820 / 0820	11B	K		Ko
44	13	" PIN 3 7	03-04-98 / 03-05-98	0845 / 0845	12	K		K
45	14	" PIN 3Q 10	03-04-98 / 03-05-98	0845 / 0845	13	K		K
46	15	" CAL 3 7	03-04-98 / 03-05-98	0920 / 0920	9A	K		K
47	16	" CAL 3Q 10	03-04-98 / 03-05-98	0920 / 0920	9B	K		K
48	17	" BZA 3 7	03-04-98 / 03-05-98	0945 / 0945	29	K		K
49	18	" BZA 3Q 10	03-04-98 / 03-05-98	0945 / 0945	28	K		K
50	19	" ARB 3 7	03-04-98 / 03-05-98	1030 / 1030	10A	K		K
51	20	" ARB 3Q 10	03-04-98 / 03-05-98	1030 / 1030	8A	K		K
52	21	" HHS 4 8	03-05-98 / 03-06-98	0820 / 0820	11A	PC		K
53	22	" PIN 4 8	03-05-98 / 03-06-98	0845 / 0845	12	PC		K

LOG BOOK

Project:Malathion/Malaoxon Ambient in Imperial Co.

Project #: C98-002

	Log #	Sample ID	Date	Time	Comments	weather o = overcast pc = partly cloudy k = clear	taken by	
54	23	MAL-CAL	03-06-98	0920	9A	PC	[illegible]	K
55	24	MAL-BEA	03-06-98	0945	29	PC	[illegible]	K
56	25	MAL-ACO	03-06-98	1030	10A	PC	[illegible]	K
57	26	MAL-TB	03-06-98	1030	Trip blank		[illegible]	K

LOG BOOK

Project:Malathion/Malaoxon Ambient in Imperial Co.

Project #: C98-002

Log #	Sample ID	Date	Time	Comments	weather o = overcast pc = partly cloudy k = clear	taken by
58	MAL-HHS 1	03 09 98 03 10 98	0820 0820	11 A	K	
59	MAL-PIN 1	03 09 98 03 10 98	0845 0845	12	K	
60	" -CAL 1	03 09 98 03 10 98	0920 0920	9A	k	
61	" - BRA 1	03 09 98 03 10 98	0945 0945	29	k	
62	" -ARB 1	03 09 98 03 10 98	1030 1030	10A	k	
63	" - HHS 2	03 10 98 03 11 98	0820 0820	11A	k	
64	" - PIN 2	03 10 98 03 11 98	0845 0845	12	k	
65	" - CAL 2	03 10 98 03 11 98	0920 0920	9A	k	
66	" - BRA 2	03 10 98 03 11 98	0945 0945	29	k	
67	" -ARB 2	03 10 98 03 11 98	1030 1030	10A	k	
68	" - HHS 3	03 11 98 03 12 98	0820 0820	11A	k	
69	" - HHS 3D	03 11 98 03 12 98	0820 0820	11B	k	
70	" - PIN 3	03 11 98 03 12 98	0845 0845	12	k	
71	" - PIN 3D	03 11 98 03 12 98	0845 0845	13	k	
72	" - CAL 3	03 11 98 03 12 98	0920 0920	9A	k	
73	" - CAL 3D	03 11 98 03 12 98	0920 0920	9B	k	
74	" - BRA 3	03 11 98 03 12 98	0945 0945	29	k	
75	" BRA 3D	03 11 98 03 12 98	0945 0945	28	k	
76	" ARB 3	03 11 98 03 12 98	1030 1030	10A	k	
77	" ARB 3D	03 11 98 03 12 98	1030 1030	8 A	k	
78	" HHS 4	03 12 98 03 13 98	0820 0820	11A	k	
79	" PIN 4	03 12 98 03 13 98	0845 0845	12	k	

LOG BOOK

Project:Malathion/Malaoxon Ambient in Imperial Co.

Project #: C98-002

Log #	Sample ID	Date	Time	Comments	weather o = overcast pc = partly cloudy k = clear	taken by
80	MAL-CAL4	03-12-98	0920			
		03-13-98	0920	9A	k	[illegible]
81	" - BRA4	03-12-98	0945			
		03-13-98	0945	29	k	[illegible]
82	" - ARB4	03-12-98	1030			
		03-13-98	1030	10A	k	[illegible]
83	" TB 4	03-13-98	1030	TRIP BLANK	k	[illegible]

APPENDIX VI

MALATHION APPLICATION METEOROLOGICAL DATA

Malathion Application Meteorological Data (15 min. averages)

Julian Date (1988)	Time	Wind Speed (mph)	Temp (F)	Barometric Pressure (hPa)	Relative Humidity (%)	Wind Direction (oriented to geo. N)
55	1041	6.6	63.1	1003	50.3	278
55	1056	9.5	62.9	1003	52.3	283
55	1111	8.3	63.7	1003	54.8	272
55	1126	12.9	64.8	1003	50.3	266
55	1141	11.5	63.3	1003	51.7	256
55	1156	12.8	64.0	1003	51.9	264
55	1211	13.7	65.7	1003	52.5	281
55	1226	13.5	64.0	1003	51.4	263
55	1241	14.9	64.8	1003	50.6	261
55	1256	15.4	61.8	1003	52.7	250
55	1311	18.6	61.5	1003	56.1	251
55	1326	16.2	62.2	1003	57.0	254
55	1341	14.2	65.1	1003	52.7	261
55	1356	12.7	66.0	1003	49.4	273
55	1411	14.1	64.7	1003	46.2	263
55	1426	17.6	64.4	1003	47.6	257
55	1441	19.7	65.2	1004	45.0	260
55	1456	15.2	64.5	1004	46.6	278
55	1511	20.9	65.2	1004	45.6	258
55	1526	19.9	65.3	1004	45.8	254
55	1541	21.6	64.9	1005	44.1	261
55	1556	19.2	64.6	1005	44.9	258
55	1611	18.1	64.4	1005	43.3	256
55	1626	17.3	63.8	1005	43.1	260
55	1641	14.0	63.4	1005	43.0	264
55	1656	17.4	63.3	1005	43.6	260
55	1711	15.0	61.7	1005	48.9	261
55	1726	14.9	60.7	1005	48.7	259
55	1741	15.7	60.0	1006	50.0	256
55	1756	13.6	59.5	1006	51.0	260
55	1811	11.9	58.7	1006	53.0	258
55	1826	14.3	58.9	1006	53.1	259
55	1841	10.9	58.1	1006	54.2	262
55	1856	4.5	55.5	1006	58.6	261
55	1911	10.8	55.5	1006	61.7	249
55	1926	12.8	56.1	1007	61.5	251
55	1941	13.1	56.5	1007	59.8	262
55	1956	13.5	56.6	1007	58.7	275
55	2011	15.0	56.8	1008	55.7	267
55	2026	14.3	56.1	1008	55.0	271
55	2041	14.7	56.0	1008	53.4	270
55	2056	11.9	55.5	1008	52.5	266
55	2111	11.2	55.3	1009	54.5	276

Malathion Application Meteorological Data (15 min. averages)

Julian Date (1988)	Time	Wind Speed (mph)	Temp (F)	Barometric Pressure (hPa)	Relative Humidity (%)	Wind Direction (oriented to geo. N)
55	2126	11.7	55.3	1009	56.3	275
55	2141	11.1	55.1	1009	56.9	266
55	2156	10.0	54.3	1009	58.1	260
55	2211	9.5	54.0	1009	60.9	258
55	2226	8.3	53.9	1009	63.2	263
55	2241	9.8	54.7	1009	64.8	264
55	2256	9.5	54.8	1009	65.0	265
55	2311	8.5	54.2	1009	66.6	266
55	2326	6.3	52.5	1009	70.3	254
55	2341	7.6	52.1	1009	73.5	263
55	2356	8.8	52.9	1009	73.4	262
56	11	4.6	52.1	1009	73.7	248
56	26	0.3	51.0	1009	75.5	225
56	41	4.3	50.7	1009	77.2	224
56	56	5.8	49.2	1009	78.1	249
56	111	6.9	51.2	1009	76.6	263
56	126	6.5	51.7	1009	72.2	261
56	141	6.0	51.6	1009	71.3	260
56	156	6.5	49.8	1009	73.8	257
56	211	7.2	51.1	1009	75.3	264
56	226	7.1	52.0	1009	72.1	280
56	241	5.2	49.6	1009	74.2	281
56	256	4.8	49.6	1009	77.9	275
56	311	4.5	48.3	1009	79.3	308
56	326	3.8	48.2	1009	81.4	321
56	341	0.1	46.8	1009	82.4	314
56	356	0.0	46.9	1009	83.8	281
56	411	1.0	48.4	1009	83.7	299
56	426	4.1	49.2	1009	81.3	285
56	441	1.7	48.0	1009	79.1	316
56	456	0.0	47.4	1009	80.0	305
56	511	0.0	47.6	1009	82.8	165
56	526	0.7	48.6	1009	84.2	234
56	541	0.8	48.2	1009	82.9	234
56	556	0.2	46.1	1009	81.8	209
56	611	0.6	46.5	1010	84.1	229
56	626	1.8	45.0	1010	83.3	228
56	641	0.1	45.5	1010	85.8	231
56	656	0.1	46.8	1010	86.8	228
56	711	0.0	49.1	1010	83.4	255
56	726	0.0	50.1	1011	83.3	265
56	741	2.2	51.9	1011	83.4	282

Malathion Application Meteorological Data (15 min. averages)

Julian Date (1988)	Time	Wind Speed (mph)	Temp (F)	Barometric Pressure (hPa)	Relative Humidity (%)	Wind Direction (oriented to geo. N)
56	756	2.9	54.0	1011	80.2	295
56	811	3.2	56.0	1011	75.4	295
56	826	4.7	57.6	1012	69.0	295
56	841	5.4	58.8	1011	59.7	316
56	856	5.9	59.9	1011	55.3	328
56	911	6.1	60.4	1012	51.3	322
56	926	5.7	61.1	1012	49.7	327
56	941	5.0	61.8	1012	47.8	331
56	956	5.4	62.3	1012	46.1	319
56	1011	5.6	63.3	1012	43.3	306
56	1026	4.5	64.2	1012	43.6	308
56	1041	5.3	64.3	1012	42.6	323
56	1056	3.7	65.5	1012	41.4	296
56	1111	4.8	65.6	1012	38.5	321
56	1126	5.2	66.0	1012	37.6	289
56	1141	5.9	65.8	1012	35.3	325
56	1156	7.4	66.1	1011	35.0	311
56	1211	4.1	67.0	1011	33.3	300
56	1226	4.8	67.0	1011	32.7	320
56	1241	5.0	67.1	1011	33.4	306
56	1256	7.5	67.2	1011	32.4	321
56	1311	5.3	67.5	1011	31.7	315
56	1326	5.1	67.7	1010	32.0	323
56	1341	5.6	67.6	1010	29.6	320
56	1356	4.6	68.1	1010	30.5	278
56	1411	1.9	68.8	1010	27.1	241
56	1426	6.7	67.8	1010	27.1	192
56	1441	5.9	68.0	1010	28.9	308
56	1456	5.1	68.1	1010	27.8	247
56	1511	3.3	68.4	1010	28.4	202
56	1526	4.7	68.2	1010	27.6	272
56	1541	2.7	68.0	1009	29.0	235
56	1556	1.4	67.8	1009	32.2	104
56	1611	2.7	67.1	1010	34.0	188
56	1626	1.0	66.9	1010	35.0	234
56	1641	0.4	66.1	1010	36.1	41
56	1656	1.1	64.9	1010	40.1	15
56	1711	0.8	63.6	1010	39.9	30
56	1726	0.0	63.0	1010	41.3	322
56	1741	0.0	62.3	1010	38.9	343
56	1756	0.0	61.7	1010	37.3	336
56	1811	0.0	61.0	1010	39.3	292

Malathion Application Meteorological Data (15 min. averages)

Julian Date (1988)	Time	Wind Speed (mph)	Temp (F)	Barometric Pressure (hPa)	Relative Humidity (%)	Wind Direction (oriented to geo. N)
56	1826	1.5	59.4	1010	43.5	235
56	1841	2.6	57.2	1010	48.6	231
56	1856	0.1	58.0	1010	45.3	255
56	1911	0.0	55.9	1010	48.0	255
56	1926	5.5	55.7	1011	48.8	252
56	1941	7.3	52.4	1011	61.3	255
56	1956	8.1	54.3	1011	66.5	261
56	2011	6.8	53.5	1011	68.1	258
56	2026	6.3	52.5	1011	71.3	249
56	2041	5.5	51.2	1011	74.3	246
56	2056	5.2	50.8	1011	76.1	250
56	2111	5.7	50.9	1011	75.7	252
56	2126	8.2	52.8	1011	72.4	257
56	2141	7.2	52.6	1012	69.8	257
56	2156	5.8	51.7	1012	71.0	252
56	2211	5.4	50.9	1011	72.7	252
56	2226	3.7	50.1	1012	74.0	242
56	2241	2.2	49.0	1011	76.2	226
56	2256	0.4	49.7	1012	77.3	234
56	2311	3.0	50.3	1012	76.8	237
56	2326	2.4	50.2	1012	75.4	252
56	2341	2.7	49.9	1012	74.3	260
56	2356	1.0	49.6	1012	73.9	272
57	11	0.0	48.6	1012	74.9	269
57	26	3.0	50.0	1012	73.6	277
57	41	3.9	49.5	1012	72.6	279
57	56	3.5	49.6	1012	72.2	278
57	111	0.4	48.9	1011	72.1	290
57	126	0.8	48.5	1011	72.7	281
57	141	0.9	49.1	1011	72.4	289
57	156	0.0	49.1	1011	70.9	287
57	211	0.2	47.7	1011	72.0	232
57	226	0.0	47.4	1011	74.6	215
57	241	0.0	49.1	1011	74.8	258
57	256	0.0	48.8	1011	73.3	287
57	311	0.0	48.2	1011	72.1	283
57	326	0.0	47.4	1011	72.9	211
57	341	0.0	48.1	1010	74.3	207
57	356	0.0	48.5	1010	75.1	304
57	411	0.0	50.4	1010	72.5	302
57	426	1.6	50.8	1010	68.2	294
57	441	1.1	50.0	1011	66.1	307

Malathion Application Meteorological Data (15 min. averages)

Julian Date (1988)	Time	Wind Speed (mph)	Temp (F)	Barometric Pressure (hPa)	Relative Humidity (%)	Wind Direction (oriented to geo. N)
57	456	0.1	49.0	1011	67.3	319
57	511	0.0	48.6	1011	69.2	314
57	526	0.0	47.7	1011	72.1	314
57	541	0.0	47.5	1011	73.1	74
57	556	0.8	47.1	1011	73.7	80
57	611	2.4	46.1	1011	75.4	129
57	626	0.1	47.5	1011	77.0	136
57	641	0.0	47.3	1011	76.6	86
57	656	2.2	47.5	1011	75.9	38
57	711	3.3	45.7	1011	79.6	109
57	726	3.3	46.6	1012	88.5	139
57	741	3.1	49.0	1012	92.7	120
57	756	1.8	51.3	1012	87.9	134
57	811	4.8	52.3	1012	81.7	137
57	826	3.2	54.6	1012	77.8	142
57	841	4.5	56.0	1012	69.3	148
57	856	3.9	57.6	1012	64.8	145
57	911	1.5	59.4	1012	60.9	156
57	926	0.1	62.9	1012	55.4	124
57	941	0.0	67.0	1013	49.5	195
57	956	0.0	66.9	1013	47.4	180
57	1011	0.0	67.0	1013	48.1	192
57	1026	0.0	67.9	1013	46.0	260
57	1041	0.0	67.6	1012	43.4	259
57	1056	0.0	69.7	1012	40.4	239
57	1111	0.0	69.5	1012	39.4	279
57	1126	0.0	71.3	1012	37.5	194
57	1141	0.0	69.1	1012	34.3	258
57	1156	0.0	69.2	1012	36.1	228
57	1211	0.0	71.8	1012	32.4	154
57	1226	0.0	70.9	1011	33.5	134
57	1241	0.3	71.1	1011	33.1	200
57	1256	0.0	71.2	1010	31.8	175
57	1311	0.0	71.2	1010	32.3	120
57	1326	0.0	73.5	1010	32.3	176
57	1341	0.1	72.8	1009	32.4	193
57	1356	0.4	72.9	1009	32.6	231
57	1411	0.5	71.1	1009	31.5	142
57	1426	0.0	73.3	1009	33.5	114
57	1441	0.0	73.3	1009	31.3	90
57	1456	0.0	73.6	1008	31.4	110
57	1511	0.0	74.3	1008	30.5	179

Malathion Application Meteorological Data (15 min. averages)

Julian Date (1988)	Time	Wind Speed (mph)	Temp (F)	Barometric Pressure (hPa)	Relative Humidity (%)	Wind Direction (oriented to geo. N)
57	1526	0.0	72.2	1008	31.7	177
57	1541	0.0	72.1	1008	33.3	81
57	1556	0.0	70.1	1008	37.1	66
57	1611	0.0	66.7	1008	43.8	54
57	1626	0.0	66.6	1008	49.6	36
57	1641	0.3	66.9	1008	52.2	36
57	1656	1.8	65.7	1008	52.9	34
57	1711	0.9	62.9	1008	56.3	21
57	1726	2.4	62.6	1008	57.9	99
57	1741	3.7	62.1	1009	58.8	57
57	1756	0.4	60.8	1009	59.7	17
57	1811	1.2	60.9	1009	59.1	169
57	1826	0.1	59.8	1009	58.3	259
57	1841	0.0	59.1	1009	59.5	355
57	1856	0.0	58.6	1009	59.8	190
57	1911	0.0	58.5	1009	61.3	288
57	1926	2.1	58.0	1010	63.8	252
57	1941	5.7	55.5	1010	71.1	260
57	1956	2.6	54.9	1010	71.2	265
57	2011	5.7	54.6	1010	71.5	246
57	2026	5.9	55.0	1010	73.6	247
57	2041	4.6	54.3	1010	74.6	256
57	2056	4.8	54.9	1010	73.6	261
57	2111	4.2	53.2	1010	74.3	243
57	2126	1.0	51.1	1010	77.2	240
57	2141	2.2	52.0	1010	79.0	272
57	2156	4.3	52.8	1010	78.0	267
57	2211	3.4	52.4	1011	76.6	272
57	2226	3.6	52.5	1011	75.1	278
57	2241	4.4	52.4	1011	74.7	276
57	2256	3.9	51.8	1011	74.9	280
57	2311	3.8	51.1	1011	76.5	282
57	2326	4.4	50.7	1011	76.9	288
57	2341	3.2	50.2	1011	77.7	285
57	2356	2.3	49.1	1011	79.0	303
58	11	1.9	48.8	1011	81.4	291
58	26	4.9	49.8	1012	80.9	291
58	41	5.7	49.5	1012	80.7	276
58	56	4.8	49.0	1012	81.2	285
58	111	5.0	49.3	1012	81.7	283
58	126	4.3	49.1	1012	81.6	288
58	141	3.9	50.1	1012	81.1	276

Malathion Application Meteorological Data (15 min. averages)

Julian Date (1988)	Time	Wind Speed (mph)	Temp (F)	Barometric Pressure (hPa)	Relative Humidity (%)	Wind Direction (oriented to geo. N)
58	156	4.2	49.8	1012	79.3	285
58	211	4.6	49.7	1012	78.8	280
58	226	4.7	49.9	1012	79.3	276
58	241	4.3	50.8	1012	78.1	276
58	256	4.1	50.6	1012	76.7	277
58	311	3.9	49.4	1012	76.3	287
58	326	3.4	49.3	1012	78.2	301
58	341	3.5	49.5	1012	78.1	295
58	356	2.9	49.5	1012	77.3	306
58	411	0.7	48.6	1012	78.0	303
58	426	0.0	47.9	1012	79.7	249
58	441	0.0	48.9	1012	82.3	257
58	456	0.7	48.4	1012	82.4	219
58	511	0.3	48.8	1012	82.3	166
58	526	3.9	43.5	1013	82.7	82
58	541	2.7	45.3	1013	92.1	100
58	556	1.7	48.3	1013	90.8	146
58	611	1.4	47.0	1013	87.9	183
58	626	0.0	47.9	1013	86.9	214
58	641	0.0	48.4	1013	85.8	221
58	656	0.0	49.7	1013	84.9	224
58	711	1.5	50.0	1013	82.1	255
58	726	0.0	50.2	1014	84.8	254
58	741	0.0	53.4	1014	87.9	255
58	756	1.4	54.8	1014	83.6	275
58	811	0.1	56.9	1014	83.5	283
58	826	1.2	58.4	1015	80.8	317
58	841	1.1	59.9	1015	78.6	324
58	856	3.2	60.3	1015	74.4	323
58	911	3.5	61.2	1015	72.6	279
58	926	1.0	63.1	1015	69.2	317
58	941	0.7	64.5	1015	63.0	251
58	956	0.8	65.7	1015	57.1	99
58	1011	1.9	65.9	1015	52.7	195
58	1026	3.7	66.5	1015	49.1	131
58	1041	3.8	67.1	1015	43.0	63
58	1056	2.0	67.7	1015	37.5	36
58	1111	3.0	67.9	1015	37.5	69
58	1126	2.7	68.2	1015	36.7	49
58	1141	2.7	67.9	1015	38.8	102
58	1156	1.5	69.1	1015	37.2	56
58	1211	0.9	70.0	1015	34.8	206

Malathion Application Meteorological Data (15 min. averages)

Julian Date (1988)	Time	Wind Speed (mph)	Temp (F)	Barometric Pressure (hPa)	Relative Humidity (%)	Wind Direction (oriented to geo. N)
58	1226	1.8	70.9	1015	34.6	74
58	1241	0.2	72.0	1014	31.3	214
58	1256	0.0	72.6	1014	30.3	257
58	1311	0.4	72.9	1014	29.9	92
58	1326	0.2	73.2	1014	30.6	177
58	1341	0.3	71.5	1014	28.9	50
58	1356	0.0	72.8	1014	30.9	70
58	1411	0.4	71.5	1014	29.9	191
58	1426	0.2	71.2	1014	31.3	129
58	1441	0.0	75.3	1013	28.4	225
58	1456	1.4	71.8	1013	28.5	55
58	1511	0.2	72.3	1013	29.9	100
58	1526	1.2	70.4	1013	30.0	52
58	1541	0.0	70.9	1013	29.8	199
58	1556	0.2	70.8	1013	30.9	84
58	1611	0.1	71.3	1013	29.5	71
58	1626	0.0	69.4	1013	34.9	107
58	1641	0.0	69.4	1013	38.9	23
58	1656	0.0	69.1	1013	33.7	28
58	1711	0.0	69.3	1013	29.2	185
58	1726	0.0	68.0	1013	32.0	334
58	1741	0.0	65.1	1013	37.0	284
58	1756	0.0	64.9	1013	33.9	260
58	1811	0.0	62.9	1013	38.2	274
58	1826	0.0	62.1	1013	41.1	265
58	1841	0.0	61.1	1013	43.9	267
58	1856	0.0	59.8	1014	47.2	260
58	1911	0.0	58.4	1014	48.6	264
58	1926	2.5	57.9	1014	52.0	132
58	1941	2.4	58.5	1014	50.4	76
58	1956	2.7	57.3	1014	51.3	63
58	2011	4.4	55.3	1014	55.5	70
58	2026	4.7	57.6	1015	49.6	76
58	2041	5.1	56.6	1015	44.8	68
58	2056	5.3	55.7	1015	44.1	72
58	2111	4.6	54.4	1015	46.8	78
58	2126	5.5	55.0	1015	44.6	83
58	2141	6.4	53.1	1015	48.2	78
58	2156	7.1	53.3	1016	49.9	70
58	2211	6.9	54.0	1016	47.5	64
58	2226	6.8	53.5	1016	46.5	65
58	2241	5.3	51.4	1016	50.7	81

Malathion Application Meteorological Data (15 min. averages)

Julian Date (1988)	Time	Wind Speed (mph)	Temp (F)	Barometric Pressure (hPa)	Relative Humidity (%)	Wind Direction (oriented to geo. N)
58	2256	5.3	50.5	1016	53.2	89
58	2311	4.5	50.3	1016	52.0	92
58	2326	4.8	51.9	1016	47.3	93
58	2341	4.3	53.1	1016	42.5	100
58	2356	4.4	54.7	1016	37.6	109
59	11	3.6	54.9	1016	36.2	120
59	26	3.7	51.7	1016	42.2	172
59	41	4.1	48.3	1016	50.3	194
59	56	3.4	48.8	1017	53.5	206
59	111	4.1	50.7	1017	49.1	197
59	126	3.5	52.5	1017	44.0	192
59	141	3.8	54.1	1017	39.6	198
59	156	3.5	51.5	1017	43.7	207
59	211	3.5	52.1	1017	44.8	207
59	226	4.1	51.2	1017	46.4	202
59	241	2.1	49.4	1017	49.4	206
59	256	1.9	50.1	1017	48.9	197
59	311	1.6	51.3	1017	47.5	199
59	326	0.1	51.7	1017	45.2	196
59	341	0.0	49.2	1017	48.5	246
59	356	0.0	47.7	1017	53.2	261
59	411	0.0	47.3	1017	57.1	265
59	426	0.0	45.8	1017	60.1	197
59	441	0.0	47.4	1017	60.5	236
59	456	0.3	46.7	1018	61.0	265
59	511	0.0	43.3	1018	65.8	273
59	526	0.0	45.1	1018	67.7	294
59	541	0.0	45.1	1018	67.3	231
59	556	0.0	46.5	1018	63.2	251
59	611	0.7	46.1	1018	62.9	244
59	626	0.0	45.8	1018	63.3	233
59	641	1.0	46.3	1019	64.0	229
59	656	2.0	46.9	1019	65.8	240
59	711	0.7	47.2	1019	69.7	270
59	726	0.0	48.8	1019	74.7	277
59	741	0.0	51.0	1020	78.2	285
59	756	0.0	52.7	1020	78.3	267
59	811	0.0	54.9	1020	73.6	274
59	826	0.0	57.5	1020	71.0	294
59	841	0.2	59.8	1020	68.4	294
59	856	1.1	60.6	1021	62.2	322
59	911	1.2	61.5	1021	57.5	322

Malathion Application Meteorological Data (15 min. averages)

Julian Date (1988)	Time	Wind Speed (mph)	Temp (F)	Barometric Pressure (hPa)	Relative Humidity (%)	Wind Direction (oriented to geo. N)
59	926	0.9	63.0	1021	55.3	304
59	941	1.3	64.1	1021	46.7	309
59	956	1.0	65.0	1021	40.3	309
59	1011	2.3	65.7	1021	34.1	313
59	1026	4.5	65.7	1021	28.7	308