UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

OPP OFFICIAL RECORD
HEALTH EFFECTS DIVISION
SCIENTIFIC DATA REVIEWS
EPA SERIES 361

MEMORANDUM

Date: August 7, 2002

Subj: Study Review of *Field Volatility of Metam-Sodium During and After Applications (MRID 42659901)*

DP Barcode: D281787

PC Code(s) : 068103 (MITC), 039003 (Metam-Sodium)

MRID: 42659901

From: Steven Weiss, Industrial Hygienist
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Attached is a review of a field volatility study entitled, *Field Volatility of Metam-Sodium During and After Applications* (cited as reference '**B.5. CARB 1993b**' in California EPA's 7/25/00 assessment of MITC). The review of the study was completed by Versar, Inc. on March 8, 2002, under the supervision of HED. It has undergone secondary review in HED and has been revised to reflect Agency policies.

(1)

Reviewer: Teri Schaeffer/Marit Espevik **Date** March 8, 2002

STUDY TYPE:

Field Volatility Study Involving Air Monitoring for MITC After Application of Metam-Sodium

TEST MATERIAL: BUSAN® 1020 and Soil-Prep® are water miscible liquids containing 33.1 percent sodium N-methyldithiocarbamate (metam-sodium) as the active ingredient. Methyl isothiocyanate (MITC) is the primary degradate of metam sodium..

SYNONYMS: The active ingredient (sodium N-methyldithiocarbamate) is also known as metam-sodium (CAS No. 137-42-8). The primary degradate (methyl isothiocyanate) is also known as MITC (CAS No. 556-61-6).

CITATION:

Author:	Leah Rosenheck, Pan-Agricultural Laboratories, Inc.
Study Director:	Dennis Morgan, Oregon-California Chemicals, Inc.
Title:	*Field Volatility of Metam-Sodium During and After Applications.*
Report Date:	January 26, 1993
Field Laboratory:	Pan-Agricultural Laboratories, Inc., 32380 Avenue 10, Madera, CA 93638
Analytical Laboratory:	Morse Laboratories, 1525 Fulton Avenue, Sacramento, CA 95825
Identifying Codes:	MRID 42659901; Pan-Ag Study No. 92158; Morse Labs Project No. ML92-0300-ICI; Unpublished.

SPONSOR:

Metam-Sodium Task Force, c/o ICI Americas, Inc., Delaware Corporate Center, 2 Righter Parkway, Wilmington, DE 19897

EXECUTIVE SUMMARY:

This purpose of this study was to assess the offsite air movement of methyl isothiocyanate (MITC), the primary breakdown product of metam sodium, following application to a field. Metam-sodium was applied by solid fixed-set sprinklers at a rate of 100 gallons of test product per acre (318 lbs ai/acre) to a 7 acre fallow field in Madera County, California. Air sampling for MITC concentrations was conducted using personal air sampling pumps located 5, 25, 125, and 500 meters from the downwind edge of the application zone. A charcoal sorbent tube was attached to each air sampling pump to collect residues over a four hour period. At each test site, duplicate samples were collected every four hours during the application and for two days following the application. Each station consisted of two charcoal vapor-collection tubes attached to a high volume air sampling pump set to run at 1 Lpm.

The Registrant provided dissipation and volatility data for MITC during and after the application. MITC values ranged from 8.6 to 1300 $\mu g/m^3$. The highest MITC residues were detected during the first sampling interval following the application and MITC levels dropped off considerably 20 hours after field application. Maximum volatilization occurred in the first eight hours after initiation of the application (11 g/ha per four hours). Dissipation half-life values were calculated

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by the Registrant as 7.91 hours (R^2= 0.934), 7.46 hours (R^2=0.915), 7.25 hours (R^2=0.548), and 9.96 hours (R^2=0.778) for the 5 m, 25 m, 125 m, and 500 m downwind samplers, respectively.

Versar calculated Time-Weighted Averages (TWAs) from each sampling station to determine off-site air movement of MITC from each distance. The 24-hour MITC TWA results ranged from 68.3 to 518 $\mu g/m^3$ (5 meters), 74 to 484 $\mu g/m^3$ (25 meters), 44.2 to 324 $\mu g/m^3$ (125 meters), and 8.97 to 66.9$\mu g/m^3$ (500 meters).

The following is a summary of some issues of concern regarding this Study Report:

- The use of two or more geographical, meteorological locations is suggested, but only one location was used.
- Air monitoring was not done in the center of the treated field and samplers were not placed at all four cardinal compass points from the center. Downwind sampling stations were established perpendicular to the prevailing northwest wind direction at 5, 25, 125, and 500 meters from the downwind edge of the application zone.
- Air sampling pumps were set at 1 Lpm and the power generator failed during the 8 to 12 hour sampling interval.
- Field fortification samples were said to represent storage stability as well. However, analysis dates are not known and the order they were analyzed in relation to the field samples is not known.

COMPLIANCE:

Signed and dated GLP, Quality Assurance, and Data Confidentiality statements were provided. The study sponsor waived claims of confidentiality within the scope of FIFRA Section 10(d) (1) (A), (B), or (C). The study sponsor and author stated that the study was conducted under EPA Good Laboratory Practice Standards (40 CFR part 160), with certain exceptions: (1) there was no intermediate storage of the test substance because it arrived in a bulk-carrier tanker truck; (2) two test substance samples collected during the study were not analyzed under GLP; (3) the identity, strength, purity, and composition of lot number 00562090 was not determined and documented prior to its use in the study; (4) the test substance mixed with the carrier was not sampled for analysis due to the instability of metam-sodium in water; and (5) the analytical method was conducted under a separate study number.

CONCURRENT EXPOSURE STUDY?: No

GUIDELINE OR PROTOCOL FOLLOWED:

The study was reviewed for compliance with applicable sections of:

* OPPTS Series 875, Occupational and Residential Exposure Test Guidelines
  Group A - Application: 875.1300 (Outdoor Inhalation Exposure)
  Group B - Postapplication Exposure Test Guidelines: 875.2500 (Inhalation Exposure Monitoring)

* OPPTS 840 Spray Drift Guidelines: 840.1000, 840.1100, and 840.1200

* OPPTS Series 835 Guidelines 835.8100 (163-3 Field Volatility Studies)

I. MATERIALS AND METHODS

A. MATERIALS

1. Test Material:

Formulation:	BUSAN® 1020 and Soil-Prep® are both water miscible concentrates and both contain 33.4% metam-sodium (3.1 lb ai/gal)
Lot/Batch # formulation:	BUSAN® 1020: Lot number - 77-355 Soil-Prep®: Lot number - 00562090
Formulation guarantee:	Purity of BUSAN® 1020 was 33.2% and the purity of the BUSAN® 1020/Soil-Prep® mixture averaged 33.6%.
Purity:	The MITC reference standard (Lot number ASW-1275-C) had a purity of 97%.
CAS #(s):	Metam-sodium: CAS 137-42-8 MITC: 556-61-6
Other Relevant Information:	BUSAN® 1020 EPA Reg. No: 1448-85 Soil-Prep® EPA Reg. No: 1448-85-2935.

A total of 1500 gallons of BUSAN® 1020 was first delivered to the test site for use in the study. On April 24, 1992, approximately 682 gallons were used during an aborted attempt to conduct this study. As a result, an additional 267 gallons of metam-sodium (supplied by Wilbur-Ellis using the product name Soil-Prep®) were delivered. The Soil-Prep® test substance was added to the remaining BUSAN® 1020 located at the test site and the mixture was used in the application.

2. Relevance of Test Material to Proposed Formulation(s):

The test products used in this study were the same product described in the product labels provided with this study. According to the Study Report, the Soil-Prep® formulation was close to same formulation as the BUSAN® 1020 product.

B. STUDY DESIGN

There was one amendment to and one deviation from the protocol. The amendment involved changing the analytical phase information to the protocol to clarify a discrepancy between the field phase study number and the analytical phase study number. The protocol deviation involved the air sampling pumps at the 5, 25, and 125 meter stations which did not run for the entire four hours during the 8 to 12 hour sampling period. This resulted in lower than expected methyl isothiocyanate residues for these stations.

1. Site Description

Test locations: This study was conducted near Firebaugh, California (Madera County) on May 2 through 4, 1992. A 6.69 acre test site in a 40 acre fallow field was treated in this study. A 40 acre cotton field was located to the south side of the site and the entire 80 acre block was

surrounded by pasture land. According to the BUSAN® 1020 label, this product is most likely to be used in North America during the fall. This study took place in the spring (May).

Areas sprayed and sampled: Metam-sodium was applied to an area of 6.69 acres for four hours.

Meteorological Data: Meteorological data were collected during the study by a portable DataLynx weather station set up at the 125 meter sampling station. Weather data were collected from the start of application through the last sampling interval. Temperature data were collected at 1.5 and 7 meters above the ground, while wind direction and speed, relative humidity, and barometric pressure were collected at 1.5 meters above the ground. Air temperatures ranged from 14°C to 34°C throughout the study. Hourly soil temperatures at 3 inches into the soil were provided in the Study Report (Appendix B). Soil temperatures ranged from 60°F to 88°F.

Barometric pressure readings after 9:13 AM on May 3, 1992 were considered to be invalid due to a malfunction with either the sensor or the data logger.

2. Application Rates and Regimes

Application Rate: The application rate was the maximum application rate of 100 gallons of test product per acre (318 lbs ai/acre). The test product was applied for a period of 4 hours which resulted in a total of 669 gallons applied.

Application Regime: Prior to application of the test product, the soil was cultivated per label requirements. The site was also pre-irrigated 90 minutes prior to the application. The product was applied once to bare ground with 0.8 inches of water for four hours. After the application, the injector pump was turned off and the sprinkler lines were flushed with water for 15 minutes. The application took place on May 2, 1992.

Application Equipment: Solid fixed-set sprinklers were used to apply the test product. The water pump and chemical nurse tank were situated at the northwest corner of the field. A booster pump was used to provide the extra pressure needed to run the full set of sprinklers. The main line of the sprinkler system ran from the booster pump diagonally across the field in a southeast direction (313°). Four rows of sprinkler pipe, each row separated by 45 feet, were placed perpendicular to the main pipe. Each row measured 1,590 feet with a sprinkler head every 30 feet, resulting in a 1,620 foot by 180 foot sprinkler swath. A Comet dual diaphragm pump, operated by a 3.55 hp Honda motor, was used to inject the test substance into the main sprinkler line.

Equipment Calibration Procedures: The injector pump was calibrated prior to the application of the test product. The pump flow rate was adjusted so that the entire test substance application would occur in four hours.

3. Field Volatility Air Sampling Procedures

Sampling Method and Equipment: MITC residues were sampled in 4 hour intervals. Downwind sampling stations were established perpendicular to the prevailing northwest wind direction at 5, 25, 125, and 500 meters from the downwind edge of the application zone. Each air sampling station was placed 1.5 meters above the ground. Each station consisted of two charcoal vapor-

collection tubes attached to a high volume air sampling pump which was set to run at 1 Lpm. A drying tube and cassette which contained a fiber glass filter and support pad were placed in front of the vapor-collection tubes to trap moisture and dust particles. The sampling tubes were changed every 4 hours. The flow rate for each pump was checked with a Kurz Mass Flow Meter and recorded after attaching new charcoal tubes and prior to removing them.

Replicates per activity:

- Replicates per sampling time: Duplicate air samples were collected at each station for each sampling interval. Four sampling stations were monitored during each sampling interval.

- Number of sampling times: There were 13 sampling intervals. Each sampling interval consisted of 4 hours.

Times of sampling: Samples were collected from the beginning of the application and continued for 48 hours after the application. The application took 4 hours.

4. Soil Sampling and Characterization

Duplicate soil samples were collected prior to the application (pre-irrigation) from several locations within the application zone. These samples were collected for moisture analysis and characterization. The predominant type of soil at this site was classified as Calhi Loamy Sand (82.7% sand, 13.3% silt, and 4.0% clay) and the soil moisture averaged 10.8% by weight. The soil samples were moderately alkali (pH = 7.9). According to the product label, application of the test product should be made when the soil moisture is about 50 to 80 percent of field capacity.

5. Sample Handling and Storage

The charcoal vapor-collection tubes were removed after each 4 hour interval, capped, labeled, and placed in resealable bags. The drying tubes were discarded and the cassettes containing the fiber glass filter and support pad were reused. The sealed bags were place in ice chests containing dry ice until they were placed in a freezer. Formulation and fortification samples were stored separately from the field samples on frozen blue ice. Samples were transported daily in ice chests with dry ice to Pan-Ag were they were placed in freezers awaiting shipment. The Pan-Ag freezers were kept at temperatures ranging from 9°F to 22°F. On May 5, 1992, the samples were placed in insulated cardboard boxes, each containing dry ice, and were shipped via overnight delivery to Morse Laboratories in Sacramento, California. The field fortification samples were packaged in a box with dry ice and shipped to Morse Laboratories on May 12, 1992. The field blanks were kept separate from the other samples in the field, storage, and shipment. All of the samples were stored frozen at Morse Laboratories at temperatures of -20°C $\pm$ 5°C until analysis. Sample analysis began on May 13, 1992 and was completed on June 1, 1992.

6. Analytical Methodology:

Extraction methods: Each charcoal vapor-collection tube was scored in front of the separation plug and the contents (charcoal and glass wool plug) were placed in a two-dram vial containing

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5.0 mL of 0.1% carbon disulfide in ethyl acetate. The vial was capped immediately. The separation plug was removed from the charcoal tube and the backup section contents were placed in another vial containing 5.0 mL of 0.1% carbon disulfide in ethyl acetate. The MITC was desorbed for a minimum of two hours with occasional agitation to facilitate desorption. Following desorption, a 1 ml aliquot of the sample was taken to gas chromatographic analysis.

Detection methods:

Table 1. Summary of GC/MS Chromatographic Conditions

GC Column	Length: 6 feet; Outer Diameter: 1/4 inch; Inner Diameter: 2 mm
Temperatures	Injector: 230°C Column: 81°C Detector: 250°C
Injection Volume	2 µL
Retention Time	Approximately 2.08 minutes
Run Time	Not reported

Method validation: Method validation was performed prior to the initiation of the study, under protocol EF-91-360 to demonstrate the validity of the methodologies to be used for MITC analysis. The validated method was a documented modification of Method No. RRC-82-35. Method validation consisted of duplicate unfortified controls and triplicate samples fortified at 1.0 µg and 50 µg. The limit of quantification (LOQ) was set at the lowest validated level (1.0 µg). Overall recoveries ranged from 75 percent to 89 percent. The average recovery for the 1.0 µg level was 80 percent and the average recovery for the 50 µg level was 83 percent. The limit of detection (LOD) and the working concentration range were not provided in the Study Report.

Instrument performance and calibration: Information regarding instrument performance and calibration for the analysis of the samples was not provided.

Quantification: Concentrations of MITC in the samples were determined directly from the standard curve using an equation provided on page 24 of the Study Report.

7. **Quality Control:**

Lab Recovery: Each set of samples was run with one blank and two fortified controls at a low level and at a high level concentration. The laboratory fortification levels ranged from 1.0 µg to 99.9 µg. Individual recoveries were within the acceptable limits of 70 percent to 120 percent. The average recoveries for each concentration is provided in Table 2.

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Table 2. Concurrent Laboratory Recoveries

1	15	88.3	8.4	75 to 110
10	1	89.0	---	89
50	5	89.6	2.5	86 to 93
99.9	9	93.2	8.4	81.1 to 108

Field blanks: Field blank sampling took place for a four-hour period during each fortification event (May 2 and May 3). Four charcoal vapor-collection tubes were used to check for background MITC levels in an area two to three miles upwind from the application zone. The samplers were set up in the same configuration as the downwind sampling stations at the test site. No MITC residues were detected in these field blank samples.

Field recovery: MITC field fortification solutions were prepared in the laboratory and shipped to the test site. While in the field, the field fortification solutions were kept in an ice chest containing blue ice. Field fortification samples were collected twice during the study (May 2 and May 3) in an area two to three miles upwind from the application zone. Duplicate sets of charcoal vapor-collection tubes, attached to operating personal air-sampling pumps calibrated to 1 Lpm, were fortified using a syringe. The charcoal tubes were fortified with MITC at 0.986 µg, 98.6 µg, and 986 µg. A glass fiber filter and a drying tube were placed in front of each tube immediately after fortification. The fortified samples were exposed to the environment for four hours (the duration of one sampling interval). At the end of the sampling interval, the charcoal tubes were removed from the tubing, capped,labeled, and placed in an ice chest containing dry ice.

In calculating the overall average recovery for each sampling day, recoveries greater than 100 percent were assumed by the Registrant to be 100 percent in the calculations. Average percent recoveries for the two sampling days were 97.8 percent and 100 percent, respectively. The registrant used the average recovery from the first set of fortifications (97.8%) to correct the first 24 hours of sample residues. Table 3 provides a summary of the field fortification results.

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Table 3. MITC Field Fortification Recoveries

5/2/92	0.986	100 (117)	100	97.8	13
		100 (117)			
	98.6	92.3	93.3		
		94.3			
	986	100 (122)	100		
		100 (117)			
5/3/92	0.986	100 (107)	100	100	5.9
		100 (107)			
	98.6	100 (101)	100		
		100 (103)			
	986	100 (118)	100		
		100 (106)			

Values in parenthesise represent the actual field fortification recoveries which were adjusted to 100 percent.
* The standard deviation is representative of the actual field fortification recoveries.

Formulation: Two formulation samples were collected from the nurse tank after the application of the BUSAN® 1020/Soil-Prep® mixture. These samples were used to make determinations of strength, purity, composition, and stability of the test substance mixture. Formulation samples were analyzed by ICI Americas' Quality Control Laboratory. The analysis confirmed that the test substance was metam-sodium with an average purity of 33.6 percent.

Storage Stability: Field fortification samples were used to demonstrate freezer storage stability and method efficiency. These samples were analyzed with the field samples to quantify any degradation or loss of material. Since all MITC field fortification recoveries were greater than 92.3 percent, the compound was considered to be stable while in storage.

II. RESULTS AND CALCULATIONS:

The Registrant used the average recovery from the first day's fortifications (97.8%) to correct residues from samples collected during the first 24 hours of sampling. Corrected residues were then adjusted based on 240 liters of air which was assumed to be the standard amount of air drawn through an air-sampling pump set at 1 Lpm for 4 hours (240 minutes). From this adjusted residue value, air concentrations were calculated and provided in units of $\mu g/m^3$ (see Table 4). The Registrant used the LOQ (1 µg) for any values below the LOQ.

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Versar calculated Time-Weighted Averages (TWAs) from each sampling station to determine off-site air movement of the test substance from each of the four cardinal directions (Tables 5 through 8; Figure 1). To calculate the TWAs, the sum of each sample's measured concentration, multiplied by the total number of minutes the sample was collected, was divided by the total time duration of the sampling interval.

TWA Off-Site Concentration=[∑(Sampling Interval Minutes x Sampling Interval Concentration)]/Total Minutes

Tables 5 through 8, summarize the MITC TWA results. The 24-hour MITC TWA results ranged from 68.3 to 518 µg/m^3 (5 meters), 74 to 484 µg/m^3 (25 meters), 44.2 to 324 µg/m^3 (125 meters), and 8.97 to 66.9µg/m^3 (500 meters). The first 24-hour TWA took place during the application (DAT-0). Sampling duration (minutes) was not provided in the Study Report. Versar back-calculated the sampling durations from the Registrant's air concentration values. However, these sampling durations did not match the "Sampling Times (Start-Finish)" as reported in Table V (pages 40-42) of the Study Report. Versar used ½ LOQ (0.5 µg) for values below the LOQ and recalculated the air concentrations accordingly.

III DISCUSSION

A. LIMITATIONS OF THE STUDY:

The following is a summary of some issues of concern regarding this Study Report:

- The use of two or more geographical, meteorological locations is suggested, but only one location was used.
- Air monitoring was not done in the center of the treated field and samplers were not placed at all four cardinal compass points from the center. Downwind sampling stations were established perpendicular to the prevailing northwest wind direction at 5, 25, 125, and 500 meters from the downwind edge of the application zone.
- Air sampling pumps were set at 1 Lpm and the power generator failed during the 8 to 12 hour sampling interval.
- Field fortification samples were said to represent storage stability as well. However, analysis dates are not known and the order they were analyzed in relation to the field samples is not known.

B. CONCLUSIONS:

Except for one sample, no residues were detected in the backup section of the charcoal residue tubes. A two-way analysis of variance (ANOVA) indicated that there were statistically significant differences ($p<0.0001$) in levels of residue for the independent variables of sampling interval and sampling station location. The highest average levels of MITC residues at each station were seen at 4 to 8 hours and 12 to 16 hours after the metam-sodium was applied. Residues dropped off sharply at the 16 to 20 hour interval.

Table 4. Summary of MITC Residues Detected at Downwind Sampling Stations

0 - 4 Hr	5	274	1.1	122	97.1	405
	5	274	1	90	78.8	328
	25	269	1	145	129	539
	25	269	1	48.6	43.4	181
	125	264	1	73.1	66.5	277
	125	264	1	71.6	65.1	271
	500	248	1.1	12.5	11	45.8
	500	250	1	12.9	12.4	51.7
4 - 8 Hr	5	230	1.1	306	290	1209
	5	230	1.1	329	312	1300
	25	235	0.9	211	239	996
	25	235	1	256	261	1089
	125	233	1	182	187	781
	125	233	1	173	178	742
	500	237	1	38.9	39.4	164
	500	237	1	38.4	38.9	162
8 - 12 Hr	5	234	1.1	17.1	15.9	66.4[c]
	5	235	1.1	9.1	8.48	35.2[c]
	25	235	1	9.71	9.92	41.3[c]
	25	238	1	8.38	8.46	35.3[c]
	125	235	1	8.64[a]	8.82	36.8[c]
	125	235	1	14.21	14.5	60.4[c]
	500	234	1	5.93	6.08	25.3
	500	234	1.1	4.86	4.53	18.9

Table 4. Summary of MITC Residues Detected at Downwind Sampling Stations (continued)

12 - 16 Hr	5	239	0.9	231	258	1074
	5	239	0.9	194	216	902
	25	238	1	213	215	895
	25	238	1	213	215	895
	125	236	1	184	187	780
	125	236	1	202	205	856
	500	235	0.9	27.4	31.1	130
	500	235	0.9	38.7	43.9	183
16 - 20 Hr	5	229	1	82.8	86.8	362
	5	229	1	78.7	82.5	344
	25	233	1	92	94.8	395
	25	233	1	80.8	83.2	347
	125	236	1	21	21.4	89.2
	125	236	1.1	26.6	24.6	102
	500	236	1	2.61	2.65	11.0
	500	236	1	2.51	2.55	10.6
20 - 24 Hr	5	239	1	72.6	72.9	304
	5	239	1.1	97.1	88.6	369
	25	237	1	79.8	80.8	337
	25	237	1	91	92.2	384
	125	237	1.1	34.2	31.5	131
	125	237	1	24.1	24.4	102
	500	237	1	2.04	2.07	8.63
	500	236	1	2.1	2.14	8.92

Table 4. Summary of MITC Residues Detected at Downwind Sampling Stations (continued)

24 - 28 Hr	5	250	1.1	41.3	36.0	150
	5	250	1.1	42.5	37.1	155
	25	250	1.1	55.5	48.4	202
	25	250	1.1	60	52.4	218
	125	248	1	29.8	28.8	120
	125	248	1	28.8	27.9	116
	500	240	1.1	11	10.0	41.7
	500	240	1.1	10.4	9.45	39.4
28 - 32 Hr	5	224	1	31.2	33.4	139
	5	224	1	30.8	33.0	138
	25	225	1	41.6	44.4	185
	25	225	1	36.4	38.8	162
	125	226	1	26.4	28.0	117
	125	226	1.1	25.4	24.5	102
	500	235	1	3.9	3.98	16.6
	500	235	1.1	4.55	4.22	17.6
32 - 36 Hr	5	243	1	15.7	15.5	64.6
	5	243	1	19	18.8	78.3
	25	241	1	28.2	28.1	117
	25	241	1	25.8	25.7	107
	125	240	1	17.5	17.5	72.9
	125	240	1.1	20.2	18.4	76.5
	500	239	1	4.65	4.67	19.5
	500	239	1	5.15	5.17	21.5

Table 4. Summary of MITC Residues Detected at Downwind Sampling Stations (continued)

36 - 40 Hr	5	237	0.9	15.8	17.8	74.1
	5	237	0.9	16.8	18.9	78.8
	25	238	1	5.1	5.14	21.4
	25	238	0.9	13.3	14.9	62.1
	125	241	1	9.5	9.46	39.4
	125	241	1	8.5	8.46	35.3
	500	240	0.9	1.45	1.61	6.71
	500	239	0.9	1.4	1.56	6.50
40 - 44 Hr	5	277	1	14.2	12.3	51.3
	5	251	0.9	12.5	13.3	55.3
	25	250	1.1	13.4	11.7	48.7
	25	249	1.1	12.8	11.2	46.7
	125	250	1	4.15	3.98	16.6
	125	250	1.1	4.5	3.93	16.4
	500	235	1.1	0.5[b]	0.47	1.94
	500	235	1.1	0.5[b]	0.47	1.94
44 - 48 Hr	5	221	0.8	10.1	13.7	57.1
	5	221	0.9	9.6	11.6	48.3
	25	221	1	8.7	9.45	39.4
	25	221	1.1	11	10.9	45.2
	125	222	1	1.75	1.89	7.88
	125	222	1.2	3.5	3.15	13.1
	500	235	1	0.5[b]	0.51	2.13
	500	235	1	0.5[b]	0.51	2.13
48 - 52 Hr	5	238	1	6.13	6.18	25.8
	5	238	1	6.45	6.5	27.1
	25	238	1.1	8.15	7.47	31.1
	25	238	1.1	8	7.33	30.6
	125	238	1	4.4	4.44	18.5
	125	238	0.9	4.15	4.65	19.4
	500	240	1.1	1.45	1.32	5.50
	500	240	1.1	1.45	1.32	5.50

a - Value represents back section of the charcoal tube. No value available for the front section.
b -Residue not detected, value represents ½ the LOQ (0.5 µg)
c - Pumps did not run for full 4-hr sampling period due to power failure.
d - Sampling duration was back-calculated from the Registrant's air concentration values. .Note that these sampling durations do not match the "Sampling Times (Start-Finish)" as reported in Table V of the Study Report. Due to this back-calculation, sample duration (minutes) might be slightly different for the same sampling station for the same sampling interval.
e- Residues from the first 24 hours were corrected for the average field fortification recovery of 97.8 percent
f- Residues adjusted to standard 240 liter (µg) = corr. Residue (µg)/[avg. Flow rate)x (sampling interval)]x 240 liters.

Table 5. Summary of MITC Residues Detected at the 5 Meter Downwind Station

0	274	405	366	366
0	274	328		
1	230	1209	1255	518
1	230	1300		
1	234	66	51	
1	235	35		
1	239	1074	988	
1	239	902		
1	229	362	353	
1	229	344		
1	239	304	336	
1	239	369		
1	250	150	152	
1	250	155		
2	224	139	138	68
2	224	138		
2	243	65	71	
2	243	78		
2	237	74	76	
2	237	79		
2	277	51	53	
2	251	55		
2	221	57	53	
2	221	48		
2	238	26	26	
2	238	27		

a - Sampling was conducted in 4 hour intervals. The first interval was during application (DAT-0).
b - Sampling duration was back-calculated from the Registrant's air concentration values. .Note that these sampling durations do not match the "Sampling Times (Start-Finish)" as reported in Table V of the Study Report. Due to this back-calculation, sample duration (minutes) might be slightly different for the same sampling station for the same sampling interval.
c - Concentration in air ($\mu g/m^3$) = corr. Residue (μg)/[avg. Flow rate)x (sampling interval)]x 1 liter/0.001 m^3.
d - The average air concentration was calculated by taking the average of the duplicate charcoal vapor collection tube samples collected at each sampling interval

Table 6. Summary of MITC Residues Detected at the 25 Meter Downwind Station

0	269	539	360	360
0	269	181		
1	235	996	1043	484
1	235	1089		
1	235	41	38	
1	238	35		
1	238	895	895	
1	238	895		
1	233	395	371	
1	233	347		
1	237	337	360	
1	237	384		
1	250	202	210	
1	250	218		
2	225	185	173	74
2	225	162		
2	241	117	112	
2	241	107		
2	238	21	42	
2	238	62		
2	250	49	48	
2	249	47		
2	221	39	42	
2	221	45		
2	238	31	31	
2	238	31		

a - Sampling was conducted in 4 hour intervals. The first interval was during application (DAT-0).
b - Sampling duration was back-calculated from the Registrant's air concentration values. Note that these sampling durations do not match the "Sampling Times (Start-Finish)" as reported in Table V of the Study Report. Due to this back-calculation, sample duration (minutes) might be slightly different for the same sampling station for the same sampling interval.
c - Concentration in air ($\mu g/m^3$) = corr. Residue (μg)/[avg. Flow rate)x (sampling interval)]x 1 liter/0.001 m^3.
d - The average air concentration was calculated by taking the average of the duplicate charcoal vapor collection tube samples collected at each sampling interval

Table 7. Summary of MITC Residues Detected at the 125 Meter Downwind Station

0	264	277	274	274
0	264	271		
1	233	781	761	324
1	233	742		
1	235	37	49	
1	235	60		
1	236	780	818	
1	236	856		
1	236	89	96	
1	236	102		
1	237	131	116	
1	237	102		
1	248	120	118	
1	248	116		
2	226	117	109	44
2	226	102		
2	240	73	75	
2	240	77		
2	241	39	37	
2	241	35		
2	250	17	16	
2	250	16		
2	222	8	11	
2	222	13		
2	238	19	19	
2	238	19		

a - Sampling was conducted in 4 hour intervals. The first interval was during application (DAT-0).
b - Sampling duration was back-calculated from the Registrant's air concentration values. Note that these sampling durations do not match the "Sampling Times (Start-Finish)" as reported in Table V of the Study Report. Due to this back-calculation, sample duration (minutes) might be slightly different for the same sampling station for the same sampling interval.
c - Concentration in air ($\mu g/m^3$) = corr. Residue (μg)/[avg. Flow rate)x (sampling interval)]x 1 liter/0.001 m^3.
d - The average air concentration was calculated by taking the average of the duplicate charcoal vapor collection tube samples collected at each sampling interval

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Table 8. Summary of MITC Residues Detected at the 500 Meter Downwind Station

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0	248	46	49	49
0	250	52		
1	237	164	163	67
1	237	162		
1	234	25	22	
1	234	19		
1	235	130	156	
1	235	183		
1	236	11	11	
1	236	11		
1	237	9	9	
1	236	9		
1	240	42	41	
1	240	39		
2	235	17	17	9
2	235	18		
2	239	19	21	
2	239	22		
2	240	7	7	
2	239	7		
2	235	2	2	
2	235	2		
2	235	2	2	
2	235	2		
2	240	6	6	
2	240	6		

a - Sampling was conducted in 4 hour intervals. The first interval was during application (DAT-0).
b - Sampling duration was back-calculated from the Registrant's air concentration values. Note that these sampling durations do not match the "Sampling Times (Start-Finish)" as reported in Table V of the Study Report. Due to this back-calculation, sample duration (minutes) might be slightly different for the same sampling station for the same sampling interval.
c - Concentration in air ($\mu g/m^3$) = corr. Residue (μg)/[avg. Flow rate)x (sampling interval)]x 1 liter/0.001 m^3.
d - The average air concentration was calculated by taking the average of the duplicate charcoal vapor collection tube samples collected at each sampling interval

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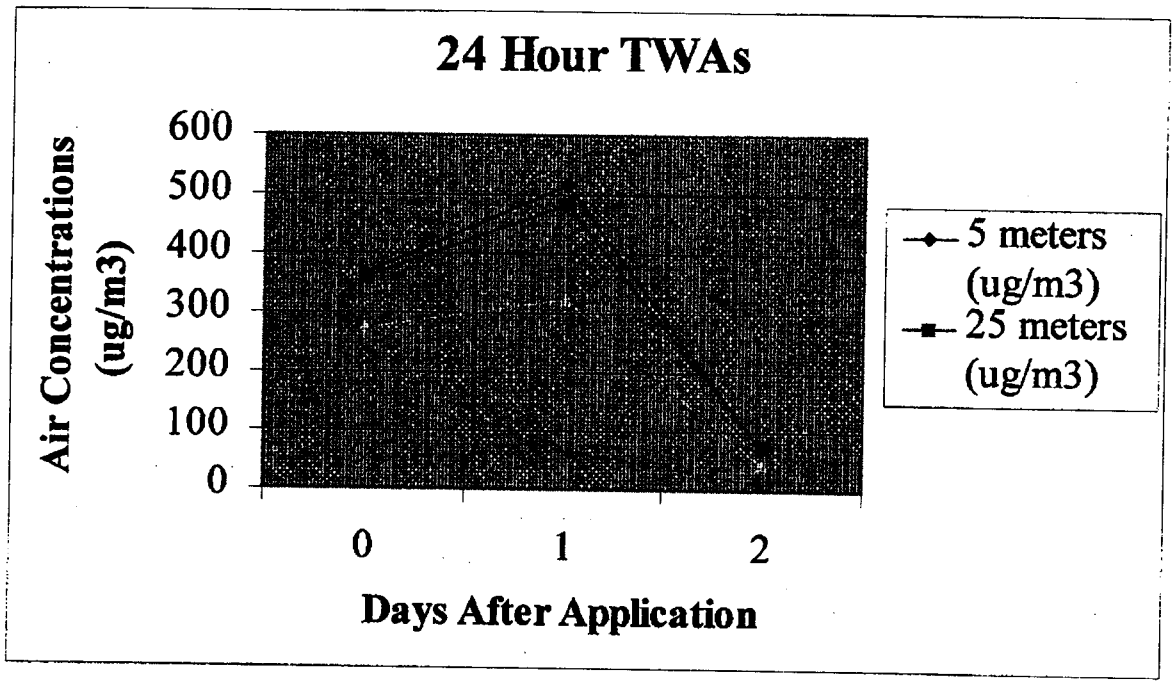
Figure 1. 24 Hour TWA Air Concentrations Versus Time.



COMPLIANCE CHECKLIST FOR REVIEWING STUDY REPORT:

The study was reviewed for compliance with applicable sections of:

* OPPTS Series 875, Occupational and Residential Exposure Test Guidelines
  Group A - Application: 875.1300 (Outdoor Inhalation Exposure)
  Group B - Postapplication Exposure Test Guidelines: 875.2500 (Inhalation Exposure Monitoring)

* OPPTS 840 Spray Drift Guidelines: 840.1000, 840.1100, and 840.1200

* OPPTS Series 835 Guidelines 835.8100 (163-3 Field Volatility Studies)

- *Investigators should submit protocols for review purposes prior to the inception of the study.* It is uncertain whether this criterion was met.

- *Expected deviations from GLPs should be presented concurrently with any protocol deviations and their potential study impacts.* This criterion was met.

- *The test substance must be the typical end use product of the active ingredient.* This criterion was met.

- *The production of metabolites, breakdown products, or the presence of contaminants of potential toxicologic concern, should be considered on a case-by-case basis.* This criterion was met.

- *The application rate should be the maximum rate specified on the label. If multiple applications are made, the minimum allowable interval between applications should be used.* This criterion was met. The maximum application rate of 100 gallons product per acre was used in this study. Only one application was made.

- *The percentage of active ingredient and formulation type should be reported. Properties of the pesticide (i.e., vapor pressure, water solubility, adsorption to soil, and texture) should also be addressed.* This criterion was met.

- *The study should be conducted domestically (USA). The site should be typical in geography, topography, soil type, season, and meteorology of those sites with intended use patterns. The use of two or more topographically and meteorologically diverse sites is recommended in order to ascertain the effects of these variables on spray drift.* These criteria were mostly met. The study was conducted domestically in a typical geographical, topographical, soil type, seasonal, and meteorological location. However, only one location was selected for this study.

- *The soil type should be adequately characterized using the USDA classification system.* This criterion was met.

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- *Field data should be documented, including area description, meteorological conditions, application data, and equipment information. Volatility (g/ha/day), air concentrations ($\mu g/m^3$), and vapor pressure (mm Hg or equivalent) should also be reported.* These criteria were met.

- *Appropriate air sampling media should be selected. The medium should entrap a high percentage of the chemical passing through it, and it should allow the elution for a high percentage of the entrapped chemical for analysis. A trapping efficiency test for the monitoring media chosen must be documented.* This criterion was met. This study followed the analytical method RRC-82-35 (dated 8/26/82). When validated, the desorption efficiency for MITC was determined using the same charcoal tubes as what were used in this study. Results ranged from 86 percent to 103 percent MITC desorbed.

- *Air monitoring techniques area (i.e., stationary) should contain sufficient samples to characterize the likely range of possible exposure concentrations, and to ensure that the reentry and/or bystander scenarios can be adequately addressed. Stationary samples should be collected from the center of treated fields and from at least 4 other locations, preferably at the cardinal compass points from the center location and at representative distances to reflect buffer zones. Air samplers should be placed at a height that is representative of the breathing zone of potentially exposed individual (i.e. 2 to 3 feet for workers removing tarps, 4 to 5 feet for bystanders downwind, etc.) At least three downwind collection sites should be used. If homes or structures are present, representative samples should be taken within the structure to establish buffer zones.* These criteria were partly met. Stationary samples were not collected from the center of the treated field. Downwind sampling stations were established perpendicular to the prevailing northwest wind direction at 5, 25, 125, and 500 meters from the downwind edge of the application zone. Each air sampling station was placed 1.5 meters above the ground.

- *The duration of the sampling interval and air flow rates should be maximized within the appropriate flow rate range to increase the potential for capturing enough residue to be quantifiable.* This criterion was met.

- *A sufficient number of replicates should be generated to address the exposure issues associated with the population of interest.* This criterion was met. Duplicate samples were collected at 13 sampling intervals with each sampling interval consisting of 4 hours.

- *Air samples should be monitored for residues at intervals which increase with time after application. Sampling should be continued until the nature of the dissipation curve has been clearly established.* This criterion was partly met. Sampling intervals did not increase with time after application. They all remained the same during and after the application. Sampling did continue until the nature of the dissipation curve was established.

- *A monitoring pump capable of producing an airflow of at least 2 L/min. should be used and its batteries should be capable of sustaining maximum airflow for at least 4 hours*

without recharging. Airflow should be measured at the beginning and end of the exposure period. These criteria were not met. The monitoring pumps were set at 1 L/min and they were run on power generators. The air sampling pumps at the 5, 25, and 125 meter stations did not run for the entire four hours during the 8 to 12 hour sampling period because the generator malfunctioned.

- *Field calibration of air monitors should be performed at the beginning and end of the sampling period.* This criterion was met.

- *An adequate number of field blanks should be analyzed for contamination. If an appropriate analytical method had not been established (i.e by NIOSH or OSHA), field fortification samples should be analyzed for correction of residue losses occurring during the sampling period. When appropriate, fortified samples and blanks should be fortified at the expected residue level of the actual field samples. Fortified blanks should be exposed to the same weather conditions.* These criteria were met. Two field blanks were analyzed for this study. Field fortification samples were not used in this study. Field blank sampling took place for a four-hour period during each fortification event

- *Retention and breakthrough studies should be performed under conditions similar to those anticipated in the field phase of the study to ensure that collected material is not lost from the medium during sampling. It is recommended that at least one test be carried out where the initial trap contains 10x the highest amount of residue expected in the field.* It is not certain if this criterion was met. There was no mention in the Study Report regarding retention and breakthrough studies.

- *Samples should be stored in a manner that will minimize deterioration and loss of analytes between collection and analyses. Storage stability samples should be extracted and analyzed immediately before and at appropriate periods during storage. The time periods for storage should be chosen so that the longest interval corresponds to the longest projected storage period for field samples.* These criteria were mostly met. All of the samples were intended to be kept in a manner that was to minimize deterioration. Field fortification samples were used to demonstrate freezer storage stability and method efficiency. However, extraction and analysis times in relevance to the field samples is not known.

- *If exposed media are to be stored prior to extraction, storage media/containers should be made of appropriate material that protects against contamination and that does not interfere with analysis.* This criterion was met.

- *Validated analytical methods of sufficient sensitivity are needed. The method must be specific for the analyte of interest. Information on method efficiency (residue recovery) and limit of quantification (LOQ) should be provided.* This criterion was met. The limit of quantification was 1 µg.

- *Analysis methods should be documented and appropriate. The analytical procedure must be capable of measuring exposure to 1 µg/hr (or less, if the toxicity of the material under study warrants greater sensitivity).* This criterion was met.

- *Method accuracy should range between 70 and 120 percent. Precision values should be less than or equal to 20 percent (coefficient of variation). The extraction efficiency of laboratory fortified controls is considered acceptable if the lower limit of the 95% confidence interval is greater than 75%, unless otherwise specified by the Agency.* This criterion was met. Average concurrent laboratory fortified sample recoveries ranged from 88 percent to 93 percent.

- *Information on recovery samples must be included in the study report. A complete set of field recoveries should consist of at least one blank control sample and three or more each of a low-level and high-level fortification. These fortifications should be in the range of anticipated residue levels in the field study. Total recovery from field-fortified samples must be greater than 50% for the study.* These criteria were met.

- *Raw residue data must be corrected if appropriate recovery values are less than 90 percent.* This criterion was met. Raw residue data did not require correction, but the Registrant corrected the raw data using the average 97.8 percent field fortification recovery.

- *Residues should be reported as µg pesticide active ingredient per sample and as an airborne concentration (µg/m^3). Distributional data should be reported, to the extent possible.* This criterion was met. Residue data were provided as µg and µg/m^3.

- *A sample history sheet must be prepared by the laboratory upon receipt of the samples.* This criterion was met.