

US EPA ARCHIVE DOCUMENT

299

DATA EVALUATION RECORD

- 1. Chemical: Diallate (Avadex®)
- 2. Citation: Applicator Exposure Study with Avadex® Emulsifiable Concentrate Herbicide Using Closed-System Tank Fills (Monsanto Report MSL-1454)
- 3. Types of Closed-Systems: Protect -0- Loader®
Chemprobe®
Chemductor®
- 4. Types of Formulations: Emulsifiable Concentrate

5. Reviewed by:

Janice K. Jensen
Chemist
Environmental Fate Branch, HED

Signature: Janice K. Jensen
Date: 3/26/81

6. Approved by:

Harold Day
Acting Chief, Review Section 4
Environmental Fate Branch, HED

Signature: Harold K. Day
Date: March 26, 1981

7. Topic: Applicator Exposure Using Closed-Systems

8. Conclusions:

- A. This study is scientifically valid.
- B. This study has application exposure data only during the use of three commercially available closed-systems.
- C. Based on applying diallate to 100 acres of land once a year 1 (using Monsanto's average values), the estimated maximum combined unit dermal and inhalation application exposures using "open" and "closed" tank fill systems are as follows:

Day	Operation	Total Body Dose ^{2,3} (ug/kg bw/day)	
		"Open"	"Closed"
1.	tank fill/application	15.4	3.4
2.	incorporation	6.3	6.3

- 1 The complete operation of tank fill, application, and incorporation takes two days.
- 2 See Table 5.
- 3 Please refer to the DER on Monsanto's Report MSL-1150, Attachment A of this report.

9. Materials and Methods:

This study was conducted near Fargo, North Dakota in October, 1980. It included triplicate tank filling operations using three commercially available closed-systems: the Protect -O- Loader[®] (Protect -O- Manufacturing Co., Redmond, Oregon), the Chemprobe[®] (Cherlor Manufacturing Co., Salinas, California), and the Chemductor[®] (Hollingsworth, Co., Boone, Iowa).

The probe-type system consisted of a metal cylindrical probe which was extended down into the 5-gallon herbicide can through the plastic spout which was cut away by a blade attached to the probe sleeve. A transfer pump, attached between the can and the spray tank, pumped the chemical from the can directly into the spray tank. After the can was empty, a garden hose was attached to a valve on the probe and a series of short rinses were delivered to wash the chemical down the sides of the can and subsequently pumped into the spray tank. Once this operation was completed, the water hose was placed over the tank opening to complete the filling (see Figure 1).

Operation of the canister-type system involved placing the 5-gallon herbicide can inside a canister of a slightly larger dimension. A metal punch on the (inside) bottom of the canister punctured the can for pumping, while closing the lid on the canister punctured the opposite end for air and rinsing. The herbicide was then pumped into the spray tank. After emptying, the can was rinsed, again using a hose attached to a valve, by delivering a series of short rinses. After rinsing, the water line was placed directly over the tank opening for filling (See Figure 2).

To determine inhalation exposure, polyurethane foam (PUF) plugs and silica gel tubes were used to trap diallate (vapor, aerosol, particulates) in the air around the operator's face. Air samples were taken using a Bendix Model 500 High Volume Air Sampler fitted with a 4" x 2" polyurethane foam plug. The air samplers were run throughout the entire time it took to complete the Avadex[®] herbicide tank fill. During a tank fill, the Bendix Air Sampler was held next to the operator's face by use of a specially designed shoulder harness. In order to do this, the air sampling pump was connected to the shoulder mounted holder using a four-inch flexible hose.

For comparative and experimental purposes, a second air sampling technique was used in parallel to the High Volume Bendix Samplers/PUF plug combination. This second technique employed small volume, battery operated DuPont personal pumps. The collection matrix in this case was silica gel packed in a glass tube (See Figure 3). These tubes are commercially available and are extensively used in industrial hygiene situations to monitor personnel exposure to chemicals during the manufacturing process. After exposure, the foam plug and silica gel tube were removed, placed in cans, and frozen until analysis.

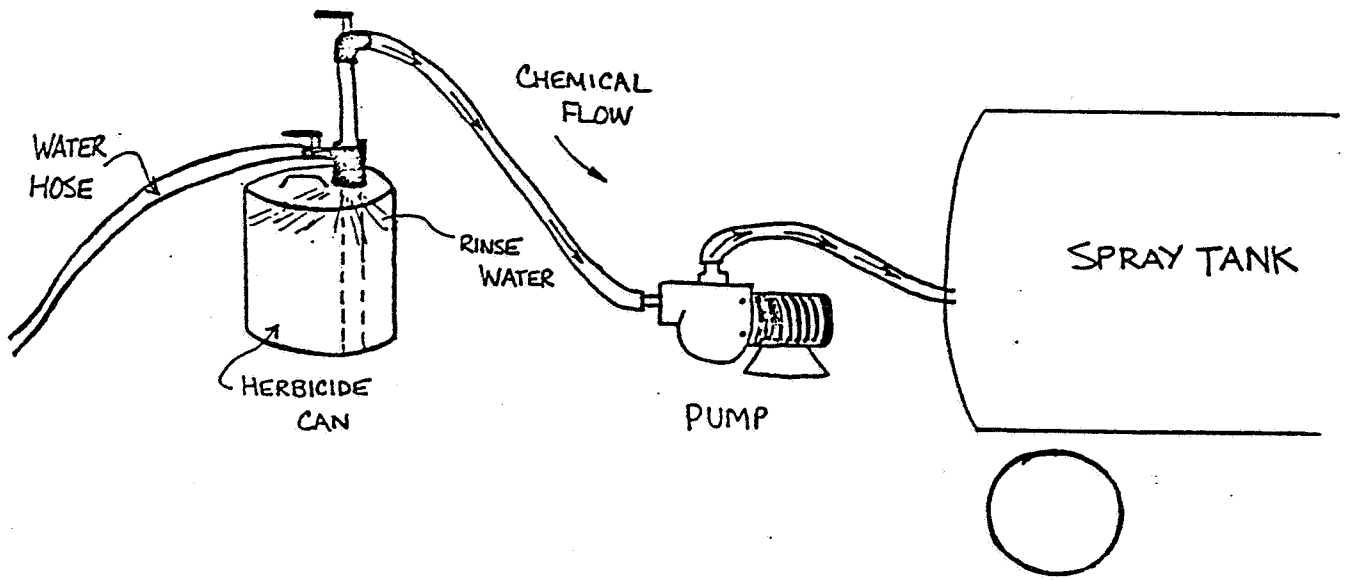


FIGURE 1 - OPERATIONAL SET-UP OF PROBE-TYPED CLOSED-SYSTEM

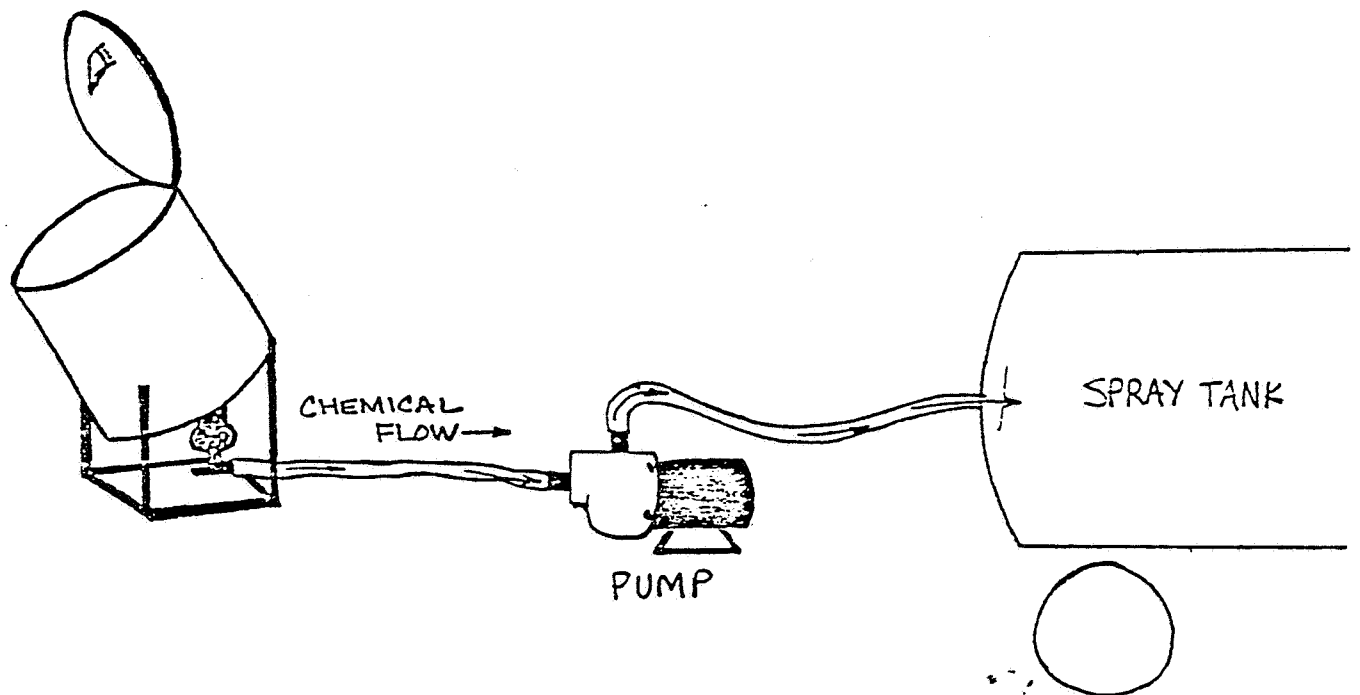


FIGURE 2 - OPERATIONAL SET-UP OF CANISTER-TYPE CLOSED-SYSTEM

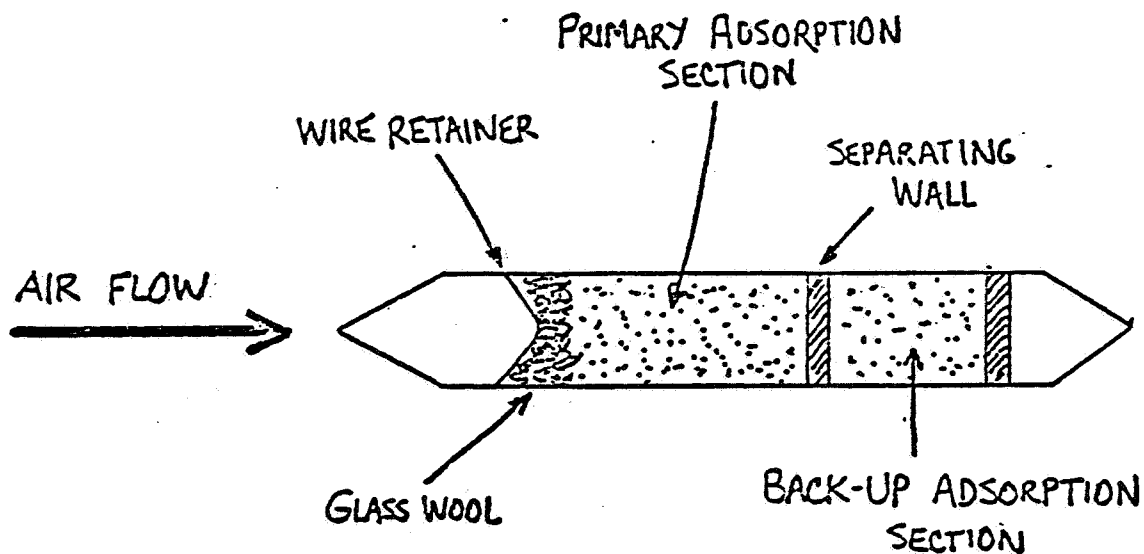


FIGURE 3 - SILICA GEL SAMPLING TUBE

Dermal exposure was measured by the use of white cotton gloves (worn under the recommended neoprene gloves) and by attaching 12 ply gauze pads 4" x 4" to the applicator's clothing. A total of 12 pads were used for each test, located as follows:

<u>Exposed</u>	<u>Under Clothing</u>
Top of Head	Right forearm
Forehead	Left bicep
Shoulder	Ankle
Chest	
Back	
Thigh	
Right bicep	
Left forearm	
Ankle	

To facilitate field operations, all of the exposed gauze pads were stapled to a glassine powder paper and attached with surgical tape to a hat for the head and forehead samples, and to disposable coveralls for all other dermal samples. A new set of coveralls and gauze pads were used in each separate tank fill replicate. The intent of the disposable coveralls was to permit quantitation of exposure with each specific type of closed-system, while avoiding cross-contamination.

The analytical methodology consisted of extraction of the various sampling media with hexane, concentration of the extract, purification using column chromatography, concentration of the column eluate, and quantitation using a GLC equipped with a Ni⁶³ electron capture

detector. The average recovery for diallate (laboratory fortification) from the foam plugs was 103%, from the silica gel absorption tubes was 85%, from the gauze pads was 99.6%, and from the gloves was 103%.

Field validation of the methodology included check and fortified samples for all the various sampling media. In air, a diallate background of 0.18 to 0.34 ug/m^3 was detected in 4 of the 18 control air samples. The remaining 14 were below the limit of detectability (0.18 ug/m^3). The field recovery for the fortified foam plugs averaged 103%. For the backup air sampling technique using silica gel absorption tubes, all values except one (2.1 ug/m^3) were below the limit of detection (1.00 ug/m^3). The field recovery for the fortified foam plugs averaged 81%. There was no break-through from the primary absorption area of the tube to the back-up section of the tube. For the gauze pads, no diallate was found in the check samples (with a limit of detection of 0.005 ug/cm^2) and field fortification showed a 93% recovery. For the glove samples, no diallate was found in the check samples and 17 field fortifications averaged 98% recovery.

Operator inhalation exposure, using polyurethane foam plug data, indicated that air concentrations of diallate in the <0.18 ug/m^3 (the limit of detection) to 1.00 ug/m^3 range were measured during the closed-system tank fill. Silica gel air samples confirmed this concentration range of 1.00 ug/m^3 or less.

Dermal deposition of diallate was represented by the analysis of cotton gloves for hands and cotton gauze for all other areas of the body. Results indicated that diallate exposure to the hands was non-detectable by this methodology (<0.06 ug/cm^2 , the sensitivity limit for the gloves). Areas of exposed dermis (regarded as the head, forehead, and shoulder area) received less than 0.005 ug/cm^2 (the sensitivity limit for the gauze pads) for all three closed-systems used. Only the thigh and ankle received any measurable diallate exposure. The highest value of 0.175 ug/cm^2 was found on the thigh, with 0.04 ug/cm^2 being the next highest value found on the ankle.

12. Results and Discussion:

This is a useful study because it is the only study in the EFB exposure files which contains field data for the use of three different commercially available closed-systems. When combined with the Data Evaluation Record for the diallate study (Montanto MSL-1150 DER attached), it is possible to evaluate the impact of closed-systems when compared with conventional "open" systems for the tank fill operation for emulsifiable concentrate formulations. This study also verifies via the use of cotton gloves under the neoprene gloves that the recommended protective clothing does indeed protect the hand area.

Table 1 presents the calculated inhalation exposure during the tank filling procedure using the 3 closed-systems; Table 2 presents the calculated dermal exposure for the same operations. It is interesting to note that Monsanto used the highest residues found in all

cases when calculating the lifetime risk numbers. The numbers presented in Tables 1 and 2 were based on average residues which gave lower estimated exposure numbers than those by Monsanto.

Tables 3 and 4 present the inhalation and dermal exposure to diallate by comparing "open" systems with "closed" systems. The values for the "open" systems were submitted in Monsanto's Study No. 1150. The DER prepared by EFB for this study is attached for the reader's convenience as Appendix A.

Table 5 presents the total body dose for both dermal and inhalation for "open" and closed systems. The summary of Table 5 is below:

Day	Operation	Total Body Dose (ug/kg bw/day)	
		"Open"	"Closed"
1.	tank fill/application	15.4	<3.4
2.	incorporation	6.3	6.3

Table 1

Applicator Exposure to Diallate Through Inhalation Exposure Using Closed Systems

Closed-System Equipment	1 Average Exposure Level ¹ (ug/m ³)	2 Range (ug/m ³)	3 Number of Samples	4 Time (in hrs) for 100 Acre Application ²	5 UNIT INHALATION EXPOSURE (ug/kg bw/day) ^{3,4}
Protect -0- Loader	0.225	<0.18 - 0.30	6	2.2	0.012
Chemprobe	0.51	0.34 - 1.00	6	2.2	0.028
Chemductor	0.205	<0.18 - 0.26	6	2.2	0.011

1 The exposure values for the polyurethane foam plugs were averaged to derive this number.

2 The average length of time for the closed-system tank fill was 20 minutes resulting in 2.2 hours of tank fill for an 100 acre application. This information was provided on page 24 of the Monsanto submission.

3 A 60 kg female body weight is assumed; a 1.5 m³/hr breathing rate is assumed.

4 Multiply the value in column 1 by the value in column 4, then multiply by 1.5 m³/hr, and then divide by 60 kg.

5 The values of <0.18 ug/m³ (the limit of detection) were computed as being 0.18 ug/m³.

Table 2

Applicator Exposure to Diallate Via Dermal Contact Using Closed Systems

Closed-System Equipment	1 Average Exposure Level ^{1,2,3} (ug/exposed area/hr)	2 Range ⁴	3 Number of Samples	4 Time (in hrs) for 100 Acres Application ⁵	5 UNIT DERMAL EXPOSURE ^{6,7} (ug/kg bw/day)
Protect -0- Loader	<16.78	N.A. ⁹	3	2.2	<0.92
Chemoprobe	<16.78	N.A. ⁹	3	2.2	<0.92
Chemductor	<16.78	N.A. ⁹	3	2.2	<0.92

- 1 The pads located on the forehead, back, and chest were considered representative of the face, back of the neck, and the "Y" of the chest which would be exposed if an applicator is wearing a long-sleeved shirt, long pants, and protective gloves.
- 2 It is assumed that a long-sleeved shirt, long pants, and protective gloves are worn (as required on the label).
- 3 Exposed areas: Face = 650 cm²; back of neck = 110 cm²; front of neck and "Y" of chest = 150 cm². Based on W. J. Hayes, Toxicology of Pesticides, 1975, page 255.
- 4 Range: Lowest and highest values from the forehead, back, and chest pads, divided by exposure time (minutes), multiplied by the appropriate surface areas listed in footnote 4 above, then multiplied by 60 minutes per hour.
- 5 This information was provided on page 24 of the Monsanto submission.
- 6 A 60 kg body weight is assumed.
- 7 Multiply column 1 by 4, then divide by 60 kg bw.
- 8 All gauze pad samples were below the limit of detection of 0.005 ug/cm².
- 9 Not applicable because all of the samples were below the limit of detection of 0.005 ug/cm².

Table 3

Inhalation Exposure to Diallate -- A Comparison Between "Open" and "Closed" Tank Fill Systems

1	2	3	4	5	6
Simulation Day	Operation	"Open" ¹	"Closed"	"Open" ^{1,4}	"Closed" ^{1,4}
		Unit Inhalation Exposure (ug/kg bw/day)	Unit Inhalation Exposure (ug/kg bw/day)	TOTAL DAILY INHALATION EXPOSURE (ug/kg bw/day)	TOTAL DAILY INHALATION EXPOSURE (ug/kg bw/day)
C 1	tank fill	0.1 ¹	0.017 ^{2,3}		
C 1	application	2.1 ¹	2.1 ¹	2.25- Day 1	2.15- Day 1
C 2	incorporation	3.9 ¹	3.9 ¹	3.9 - Day 2	3.9 - Day 2

Unit inhalation exposure values for "open" system tank fill, application, and incorporation can be found in the attached Table 3 for the Data Evaluation Record prepared by EFB for Monsanto Study No. 1150. (Attachment A) Unit inhalation exposure values for "closed" system tank fill can be found in this report in Table 1, column 5. The average value from column 5 was used. Please refer to footnotes in Table 1 of this DER for an explanation of the assumptions used to derive this value. A 100% lung absorption rate is assumed. Additive totals of tank fill and application values, multiplied by 100% absorption rate.

Table 4

Dermal Exposure to Diallate -- A Comparison Between "Open" and "Closed" Tank Fill Systems

1	2	3	4	5	6	
Formulation	Day	Operation	Unit Dermal Exposure (ug/kg bw/day)	"Open" ¹	"Closed" ²	TOTAL DAILY DERMAL EXPOSURE ³ (ug/kg bw/day)
EC	1	tank fill		120	<0.922	
EC	1	application		12	12 ¹	13.2 ¹ , 4- Day 1
EC	2	incorporation		24	24 ¹	2.4 ¹ - Day 2
						2.4 ¹ - Day 2

- 1 Unit dermal exposure values for "open" system tank fill, application, and incorporation can be found in the attached Table 3 from the DER prepared by EFB for Monsanto Study No. MSL-1150. (Attachment A)
- 2 Unit dermal exposure values for "closed" system tank fill can be found in this DER in Table 2, column 5.
- 3 A 10% skin absorption rate is assumed.
- 4 Additive totals of tank fill and application values, multiplied by the 10% absorption rate.

Table 5

Total Body Dose Estimates: Combined Inhalation and Dermal Exposure to Diallate -- A Comparison Between

		<u>"Open" and "Closed" Systems</u>						
1	2	3	4	5	6	7	8	
mulation Day Operation		<u>Total Daily Inhalation Exposure¹</u> <u>(ug/kg bw/day)</u>	<u>"Open"</u>	<u>"Closed"</u>	<u>Total Daily Dermal Exposure²</u> <u>(ug/kg bw/day)</u>	<u>"Open"</u>	<u>"Closed"</u>	<u>TOTAL BODY DOSE DERMAL AND INHALATION^{3,4}</u> <u>(ug/kg bw/day)</u>
1	tank fill/application	2.2	2.1	13.2	<1.3	15.4	3.4	
2	incorporation	3.9	3.9	2.4	2.4	6.3	6.3	

1 Total daily inhalation exposure values are from Table 3, columns 5 and 6.

2 Total daily dermal exposure values are from Table 4, columns 5 and 6.

3 Total body dose dermal and inhalation are the additive totals from columns 2 and 4 for "open" systems, and from columns 3 and 5 for "closed" systems.

4 A 60 kg body weight is assumed as also is a 1.5 m³/hr breathing rate. Please refer to the footnotes in Tables 1 - 4 for explanation.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

U.S. GOVERNMENT PRINTING OFFICE: 1979-0-277-000

12 JAN 1981

Attachment A

MEMORANDUM

SUBJECT: Data Evaluation Record for Diallate (Monsanto Report No. MSL-1150)

FROM: Chemist
Environmental Fate Branch
Hazard Evaluation Division (TS-769)

TO: Ester Saito
Acting Section Chief, CRB 3
Special Pesticide Review Division (TS-791)

THRU: Emil Regelman, Acting Chief, Review Section 4, EFB, HED

The Applicator Exposure Study for Avadex® (Diallate) Herbicide Under Actual Field Conditions, Monsanto Report No. MSL-1150 dated May, 1980 has been reviewed. The Data Evaluation Record for this study is enclosed.

If you have any questions about this DER, please call me at 557-7347.


Janice K. Jensen

Attachment

cc: Judy Heckman, HED
David J. Severn, EFB/HED
Emil Regelman, EFB/HED

DATA EVALUATION RECORD

1. Chemical: Diallate (Avadex®)
2. Citation: Applicator Exposure Study for Avadex® Herbicide Under Actual Field Conditions. Monsanto Report No. MSL-1150 dated May, 1980.
3. Types of Application: Boom Spray, Spray/Harrow
4. Types of Formulations: Emulsifiable Concentrate
5. Reviewed by:

Janice K. Jensen
Chemist
Environmental Fate Branch, HED

Signature: Janice K. Jensen
Date: 1/8/81

6. Approved by:
Emil Regelman
Acting Chief, Review Section 4, EFB, HED

Signature: Emil Regelman
Date: 1/2/81

7. Topic: Applicator Exposure
8. Conclusions:

- A) This study is scientifically valid.
- B) This study has applicator exposure data for diallate, emulsifiable concentrate formulations (EC), during mixing/loading, application, and incorporation.
- C) Based on applying diallate to 100 acres of land once a year¹, using Monsanto's average values, the estimated maximum combined unit dermal and inhalation applicator exposures are as follows:

<u>Day</u>	<u>Operation</u>	<u>Total Body Dose (ug/kg bw/day)²</u>
1	tankfill/application	15.4
2	incorporation	6.3

¹The complete operation, however, takes two days.
²See Table 3

9. Materials and Methods:

This study was conducted near Fargo, North Dakota in October, 1977. It included triplicate operations in four different wheat or sugar beet fields for mixing/loading, applying, and incorporating the wild oat herbicide diallate, using an EC (4 pounds ai/gallon) formulation.

Diallate was applied to four fields. Emulsifiable concentrate applications were made on six plots, three with a spray harrow apparatus (boom mounted 12 inches above the ground) and three with a boom sprayer (boom mounted 18 inches above the ground), each delivering 1.25 lbs ai/acre. The incorporation was done within 24 hours after application using a 30-ft. Melroe multiweeder pulled by a tractor with a cab.

Eighteen separate operator exposure measurements were made as follows:

<u>Exposure Test</u>	<u>Number of Tests</u>
Tank filling of the spray/harrow device	3
Tank filling of the boom sprayer	3
Application using spray/harrow	3
Application using boom spray	3
Second incorporation of the spray/harrow plots	3
Incorporation of boom spray plots	3
Total	18

All tests were run from start to finish of each operation providing a time weighted average exposure measurement.

The sampling techniques were designed to measure dermal and inhalation exposure during tank filling, spraying, and incorporation. Air samples were taken using a Bendix Model 500 High Volume Air Sampler fitted with a 4" x 2" polyurethane foam plug. The air samplers were run throughout all of the operations. Dermal exposure was measured by attaching 4" x 4" gauze pads to the operator's body. The sampling locations included the head (on a hat), forehead, shoulder, chest, and back. Dermal exposure to the hands was measured by using white cotton gloves. Soil samples were also taken after each application.

The analytical methodology consisted of extraction of the various sampling media (except soil) with hexane, concentration of the extract, purification using column chromatography, concentration of the column eluate, and quantitation using a GLC equipped with a Ni⁶³ electron capture detector. The soil was extracted with iso-octane and isopropyl alcohol, filtered, diluted, and quantitated in the same way as the rest of the samples. The average recovery for diallate from the foam plugs was 91%, from the gauze pads was 85%, from the cotton gloves was 85%, and from soil was 68%.

Five control field studies were run: three studies by operating tractors and application equipment without herbicide for about one hour while collecting air, glove, and gauze samples; and two studies by monitoring air levels at a stationary position in the farmer's yard. Control field checks (12) were made. Levels of diallate: in air, averaged 14.2 ug/m³ (0.04 - 54.7)(in the foam plugs, the equipment was contaminated); in the gloves, averaged 0.7 ug/cm² (0.349 - 1.049); and in the gauze pads, averaged 0.14 ug/cm² (0.004 - 0.491).

10. Results and Discussion:

This is a useful study because it is the only study in the EFB exposure files which contains field data for diallate applicator exposure.

Because a teratogenicity trigger was suspected, the data submitted by Monsanto were calculated to give maximum possible exposure on each day of application. It was assumed that tankfill and application were completed on Day 1, and that incorporation was completed on Day 2.

Table 1 presents the calculated inhalation exposure; Table 2 presents the calculated dermal exposure. It is interesting to note that Monsanto used the highest residues found in all cases. The numbers presented in Tables 1 and 2 were based average residues found which gave lower exposure numbers than those estimated by Monsanto. Attachment A contains a sample of how these calculations were made.

Table 3 presents the total body dose (ug/kg bw/day) - dermal and inhalation calculations. The results are shown below:

<u>Day</u>	<u>Operation</u>	<u>Total Body Dose (ug/kg bw/day)</u>
1	tank fill/application	15.4
2	incorporation	6.3

The assumptions made about protective clothing, body weight, breathing rate, etc. can be found in the footnotes in Tables 1 and 2.

Table 1

Applicator Exposure to Diallate Through Inhalation

Operation	1 Average Exposure Level (ug/m ³) ¹	2 Range (ug/m ³)	3 Number of Samples	4 Time (in hrs) for 100 Acre Application	5 UNIT INHALATION EXPOSURE (ug/kg bw/day) ²
Tank-fill (EC)	4.6	0.7 - 7.1	6	0.5	0.1
Application (EC)	10.2	1.9 - 29.6	7	8.3	2.1
Incorporation (EC)	18.9	2.0 - 36.1	7	8.3	3.9

¹Inside tractor cab air concentration values were used for incorporation and application operations (Monsanto's Tables VII and VIII).

²A 60 kg female body weight is assumed; a 1.5 m³/hr breathing rate is assumed.

³Multiply the value in column 1 by column 4, then multiply by 1.5 m³/hr, and then divide by 60 kg.

Table 2

Applicator Exposure to Diallate Via Dermal Contact

Operation	1 Average Exposure Level ^{1,2,3,4}	2 Range ^{1,5}	3 Number of Samples	4 Time(in hrs) for 100 Acre Application	5 UNIT DERMAL EXPOSURE (ug/kg bw/day) ^{6,7,8}
Bank-fill (EC)	14443	308 - 68,923	6	0.5	120
Application (EC)	87	16 - 175	6	8.3	12
Incorporation (EC)	173	18 - 376	6	8.3	24

¹ ug/exposed area/hour.

² The pads located on the forehead, back, and neck were considered representative of the face, back of neck, and "V" of chest which would be exposed if applicator is wearing long-sleeved shirt and protective gloves.

³ It is assumed that a long-sleeved shirts and protective gloves are worn.

⁴ Exposed Areas: face = 650 cm²; back of neck = 110 cm²; front of neck and "V" of chest = 150 cm². Based on W.J. Hayes, Toxicology of Pesticides, 1975, page 255.

⁵ Range: lowest and highest values from the forehead, back, and chest pads, divided by exposure time (min), multiplied by 60 min/hr, multiplied by the appropriate surface areas listed in footnote 4.

⁶ Sample calculations can be found in Attachment A.

⁷ A 60 kg body weight is assumed.

⁸ Multiply column 1 by column 4, then divide by 60 kg bw.

Table 3

Total Body Dose Estimates - Combined Inhalation and Dermal Exposures

1	2	3	4	5	6	7	8	TOTAL BODY DOSE-DERMAL & INHALATION ⁷ (ug/kg bw/day)
Unit Inhalation Exposure ^{1,2} Per Day ^{1,3}	Inhalation Exposure ^{1,2} Per Day ^{1,3}	Inhalation Assumed Absorption Rate (%)	Total Daily Inhalation Exposure ^{1,4}	Unit Dermal Exposure ^{1,5} Per Day ^{1,3}	Dermal Exposure Assumed Absorption Rate (%)	Total Daily Dermal Exposure ^{1,6}	Total Daily Dermal Exposure ^{1,6}	
1* 0.1			120					
1** 2.1	2.2	100	2.2	12	132	10	13.2	15.4 - Day 1
2*** 3.9	3.9	100	3.9	24	24	10	2.4	6.3 - Day 2

Tankfill

* Application

** Incorporation

ug/kg bw/day (please refer to footnotes in Tables 1 and 2 for explanation of assumptions used).

Unit inhalation values are from Table 1, column 5.

Additive total of tankfill values and application values.

Column 2 multiplied by column 3.

Unit dermal exposure values are from Table 2, column 5.

Column 6 multiplied by column 7.

Additive total of columns 4 and 8.

ATTACHMENT A

SAMPLE CALCULATIONS

1. Dermal; EC formulation; tankfill and mix (Monsanto Tables IX and X)

- A. Calculate the average ug/cm²/min for forehead pads listed for tank fill - EC (from Monsanto Tables IX and X).

<u>Monsanto raw data</u> <u>ug found (cm²)</u>	<u>Exposure</u> <u>time (min)</u>	<u>ug/cm²/min</u>
0.559	1.7	0.328
0.045	2.0	0.023
3.283	2.0	1.642
0.033	5.0	0.007
0.017	1.3	0.013
0.009	2.8	0.003

Average 0.336

- B. Using the same methodology, calculate the average ug/cm²/min for the pads labelled chest and back.
- C. Multiply the pad values times the appropriate skin surface area (assuming long-sleeved shirt and protective gloves are worn). See footnotes 1, 2 and 3 in Table 2 of this DER) to get the average ug/min. These were then totaled.

<u>pad location</u>	<u>average</u> <u>ug/cm²/min.</u>	<u>Skin Area</u> <u>exposed (cm²)</u>	<u>Average</u> <u>ug/min.</u>
forehead	0.336	650	218.4
back	0.092	110	10.1
chest	0.081	150	<u>12.2</u>

Total 240.7

- D. The totaled average ug/min (240.7) was multiplied by 60 min/hr to convert the number into an average exposure level (ug/exposed area/ hour) (Table 2, column 2).

$$240.7 \frac{\text{ug}}{\text{min}} \times 60 \frac{\text{min}}{\text{hr}} = 14442 \frac{\text{ug}}{\text{hr}}$$

- E. The range was calculated in Table 2, column 3 by selecting the lowest and highest values from the forehead, back, and chest pads listed in Monsanto's Tables IX and X, and carried through the mathematics described in A-D of this attachment.

- F. The time (in hours) for 100 acre application per operation was given by Monsanto in Monsanto's Table XVII.
- G. Assuming a 60 kg female (used because of a suspected teratogenicity trigger), the unit dermal exposure per day was calculated.

$$14442 \frac{\text{ug}}{\text{hr}} \times 0.5 \frac{\text{hr}}{\text{day}} \div 60 \text{ kg} = 120.4 \text{ ug/kg bw/day}$$

- H. On Table 3, in column 5, add values for tankfill and application to get column 6.

$$\begin{array}{r} 120.4 \\ 12.0 \\ \hline 132.4 \end{array} \text{ ug/kg bw/day}$$

- I. Multiply this number by assumed 10% skin absorption rate.

$$132.4 \frac{\text{ug}}{\text{kg bw-day}} \times 0.1 = 13.2 \frac{\text{ug}}{\text{kg bw-day}}$$

- J. Add values in columns 4 and 8 to get total body dose (ug/kg bw/day) for Day 1.

$$2.18 + 13.2 = 15.4 \text{ ug/kg bw/day} - \text{Day 1}$$

- K. Repeat same procedure for other tasks.