

Experimental Use Permit
withdrawn B.C. 7-2-85

Shaughnessy #: 123301

Due Date: 6/20/85

Init: _____

To: H. Jacoby
Product Manager #21
Registration Division (TS-767)

From: Joseph C. Reinert, Ph.D., Chief
Special Review Section
Exposure Assessment Branch
Hazard Evaluation Division (TS-769C)

Report Hatch for

Attached please find the EAB review of...

Reg./File No.: 359-EUP-AI

Chemical: Fosetyl-Al

Type Product: Fungicide

Product Name: Aliette

Company Name: Rhone-Poulenc

Submission Purpose: Worker Exposure Assessment to support EUP

ZBB Code: _____

ACTION CODE: 740

Date In: 05/07/85

EAB # 5497

Date Completed: 6/20/85

TAIS (level II) _____ Days

_____ 5

Deferrals To:

_____ Ecological Effects Branch

_____ Residue Chemistry Branch

_____ Toxicology Branch

_____ Benefits and Use Division

1.0 INTRODUCTION

Rhone-Poulenc Inc. has applied for an experimental use permit for Aliette® fungicide to be used on turf. Aliette® is a wettable powder formulation of Aluminum tris(O ethyl phosphonate) containing 80 percent active ingredient. For test purposes the fungicide is to be applied at rates of 4 and 8 oz of Aliette® per 1000 ft². A total 7.2×10^5 ft² will be treated. The study will be conducted in 16 states, each with 6 treatment areas of 7500 ft² (22500 ft² for each treatment level) for a total of 45000 ft² per state. The average number of applications per treatment area will be 4. Since EAB has no exposure data for the application of Aliette® to turf, the assessment was conducted using data from surrogate studies found in the literature. A number of assumptions were required:

- 1) An average worker weighs 70 kg with a standard surface area (1).
- 2) One person will apply the material to 45000 ft², the total area to be treated in each state.
- 3) The clothing worn by workers in the surrogate studies ranged from shorts and shoes to impervious overalls and respirators. The data are not adjusted for the effects of protective clothing.
- 4) Exposures are not adjusted for dermal penetration.
- 5) Exposure of the mixer/loaders is dependent on the total amount of material handled.
- 6) Exposure of the applicators is dependent on the rate of application.

2.0 SUMMARY OF SURROGATE STUDIES

2.1 British Agrochemicals Association Limited (BAAL) Study

BAAL measured the exposure of mixer/loaders and applicators to the herbicide 2,4-D (2). The pesticide was applied using a tractor drawn hydraulic sprayer, a tractor mounted hydraulic sprayer, a tractor mounted controlled droplet applicator (CDA), a knapsack sprayer with a 1 meter boom, and a knapsack sprayer with a single lance. Only the ground boom equipment will be considered in this assessment. 2,4-D was applied at a rate of 1.2 lbs ai per acre to grassland. Concentrations of material were 0.7 and 3.2 percent for the hydraulic sprayers and CDA, respectively. Disposable coveralls, socks, and gloves were used to determine dermal exposure. Hoods were worn during the spraying operation only. Socks, gloves, hoods and sectioned coveralls were wrapped separately in aluminum foil and refrigerated prior to analysis. Respiratory exposure was estimated by drawing air through glass fiber filters attached to the worker's collar at a rate of 4 liters per

minute. 2,4-D was quantified by HPLC. Respiratory exposure values were below the limit of detection for all ground boom mixer/loaders and applicators. The potential dermal exposures are summarized in Table 1.

Table 1. Dermal exposure of mixer/loaders and sprayers to 2,4-D

Equipment Used	Total Exposure Mixer/loader (ug/kg BW/oz handled)	Percent of Total on Hands	Total exposure Sprayer (ug/kg/hr)	Percent of Total on Hands
Tractor mounted hydraulic sprayer	8.8	76	6.1×10^2	66
Tractor drawn hydraulic sprayer	3.3	32	5.8×10^2	58
Controlled Droplet Applicator (CDA)	3.8	94	1.4×10^3	86
MEAN	5.3	67	8.6×10^2	70

2.2 Exposure from application of pesticides to turf

Daniel et al. (3) monitored the exposure of workers applying pesticides to golf courses. The chemicals tested, application rates, and application equipment used are presented in Table 2. Dermal exposure was measured using gauze pads attached to the skin on the wrists, ankles, front of body (upper and lower) and back (upper and lower). Respiratory exposure was determined by drawing air through a membrane filter using a personal sampling pump. Unfortunately exposure of the hands, upper arms, and thighs was not measured. The reviewer assumed that the exposure of the arms and legs was uniform and could be estimated by the wrist and ankle pads, respectively. The surface areas used in this assessment are presented in Table 3. It was also assumed that the hands added an additional 70 percent to the total exposure (2). Exposure was measured throughout the work period and was not separated into mixer/loader and applicator values. Exposure values are summarized in Table 4.

Table 2. Pesticide Formulations and Equipment Used in the Treatment of Golf Courses.

Pesticide	Formulation	Application Rate (lb ai/A)	Equipment Used
Benomyl	50% WP	0.95	Hand held sprayer
Benomyl	50% WP	1.1	Vehicle mounted boom
Cycloheximide		2.7	Vehicle mounted boom
Cadminate	60% WP	1.3	Hand spray
Benomyl	50% WP	1.9	Field jet nozzle
Cycloheximide		4.0	Field jet nozzle
Cadminate	60% WP	1.0	Hand spray
Thiophanate	50% WP	0.63	Manually pushed boom
Trichlorfon	80% SP	7.5	Manually pushed boom
Thiophanate	50% WP	2.2	Manually pushed boom
Carbaryl	50% WP	11	Manually pushed boom

Table 3. Dermal Pad Locations and Representative Body Surface Areas¹.

Pad Location	Representative Body Parts	Surface Area (cm ²)
Wrist	Upper arms, forearms	2530
Ankle	Thighs, lower legs	4630
Chest (2 pads)	Chest, stomach, front of neck	3700
Back (2 pads)	Back, back of neck	3660

¹ from Reference (1).

Table 4. Estimated Exposures of Workers to Pesticides Applied to Golf Course Turf.

Pesticide	Application Method	Exposure (ug/kg/hr) ¹						Total Dermal + Hands ²	Respiratory ³
		Chest	Back	Legs	Arms	Total	Total		
Benomyl	Hand held spray	2.8	2.8	3.5	5.6	15	26	0.63	
Benomyl	Vehicle mounted boom	5.0	5.0	6.3	3.4	20	34	1.1	
Cycloheximide	Vehicle mounted boom	0.40	0.40	0.50	1.2	2.5	4.3	0.91	
Cadmate	Hand spray	5.1	6.7	4.2	118	134	228	0.45	
Benomyl	Field jet nozzle	3.2	3.2	4.0	51	61	104	0.79	
Cycloheximide	Field jet nozzle	0.26	0.26	0.32	0.18	1.0	1.7	0.63	
Cadmate	Hand spray	0.50	0.49	1.3	14	16	27	0.63	
Thiophanate	Manually pushed boom	0	0	0	0	0	0	0	
Trichlorfon	Manually pushed boom	0	0	0	0	0	0	0	
Thiophanate	Manually pushed boom	0	0	0	2.4	2.4	4.1	0	
Carbaryl	Manually pushed boom	17	6.2	626	113	762	1296	0	
MEAN		3.4	2.5	65	31	1.0 x 10 ²	1.7 x 10 ²		

$$1 \text{ Exposure of Body Part (ug/kg/hr)} = \frac{\text{Total ug on pad(s)}}{\text{Total Surface Area of pad(s)}} \times \frac{\text{Surface area of Body Part}}{\text{Duration of work period (min)}} \times \frac{60 \text{ min}}{\text{hour}} \times \frac{1}{70 \text{ kg}}$$

2 Assumes an additional 70 percent due to exposure of the hands.

$$3 \text{ Respiratory Exposure (ug/kg/hr)} = \text{Air concentration (ug/m}^3\text{)} \times 1.2 \text{ m}^3\text{/hr} \times 1/70 \text{ kg BW}$$

2.3 Exposure of workers to pentachloronitrobenzene (PCNB)

Daniel et al. (4) measured exposure of 2 workers applying Actidione RZ to golf course fairways. Actidione RZ is a wetttable powder formulation containing 75 percent PCNB as the active ingredient. The material was applied at a rate of 0.38 oz ai per 1000 ft² using a tractor mounted ground boom. The spray liquid was applied at 0.7 gallons per 1000 ft². Tractor tanks were filled from a 500 gallon make up tank to speed the refilling operations. Workers wore short sleeved shirts and long pants. Dermal exposure was measured with gauze pads located outside the clothing or on exposed skin on the wrists, knees, and upper thoracic area, both front and back. Unfortunately exposure of the hands, typically the site of highest exposure, was not measured. The reviewer assumed that an additional 70 percent was added to the exposure due to exposure of the hands (2). The reviewer also assumed that the exposure of all parts of the arms and legs was uniform. Respiratory exposure was measured by drawing air through glass fiber cassettes and Tenax tubes. The tubes, filters, and pads were extracted with acetone, concentrated, and quantified by HPLC. The mean exposures of the workers are summarized in Table 5.

Table 5. Exposure of Workers to PCNB Applied to Turf.

<u>Body Part</u>	<u>Surface Area (cm²)</u>	<u>Exposure (ug/kg/hr)</u>
Chest, front of neck	3700	0
Back, back of neck	3660	0
Legs	4630	8.5
<u>Arms</u>	<u>2530</u>	<u>19</u>
Total Dermal (excluding hands)		28
Total Dermal (including hand estimate) ¹		41
Respiratory		0

¹ Assumes an additional 70 percent from hand exposure.

3.0 Calculation of exposure to Aliette®

3.1 Applicators

In order to use the data from surrogate studies to estimate exposure to Aliette®, the data must be adjusted by the ratio of the rates of application:

$$\text{Exposure to Aliette® (ug/kg/hr)} = \text{exposure to surrogate} \times \frac{\text{Application rate of Aliette®}}{\text{Application rate of surrogate}}$$

The mean rate of application for active ingredient in Aliette®, 4.8 oz per 1000 ft², was used for this assessment. The estimated exposures are summarized in Table 6. The reviewer assumed that a single worker performs all of the applications in a state. The total area treated in a year would be:

$$\begin{aligned} \text{Total area (ft}^2\text{)} &= \frac{22500 \text{ ft}^2}{\text{level}} \times 2 \text{ levels} \times \frac{4 \text{ applications}}{\text{year}} \\ &= 1.8 \times 10^5 \text{ ft}^2 \text{ per year} \end{aligned}$$

BUD (5) estimates that 5 acres of turf can be treated in one hour. The approximate time that an individual would spend applying Aliette® under these experimental conditions would be:

$$\begin{aligned} \text{Hours per year} &= \frac{1.8 \times 10^5 \text{ ft}^2}{\text{year}} \times \frac{1 \text{ acre}}{43560 \text{ ft}^2} \times \frac{12 \text{ min}}{\text{acre}} \times \frac{1 \text{ hour}}{60 \text{ min}} \\ &= 0.83 \text{ hrs/year} \end{aligned}$$

The annual exposures would be:

Dermal

$$\begin{aligned} \text{Annual exposure (ug/kg/yr)} &= 1.2 \times 10^3 \text{ ug/kg/hr} \times 0.83 \text{ hr/year} \\ &= 1.0 \times 10^3 \text{ ug/kg/yr} \end{aligned}$$

Respiratory

$$\begin{aligned} \text{Annual Exposure (ug/kg/yr)} &= 3.5 \text{ ug/kg/hr} \times 0.83 \text{ hr/year} \\ &= 2.9 \text{ ug/kg/yr} \end{aligned}$$

Table 6. Estimated Exposure of Workers to Aliette® from Treatment of Turf.

Surrogate compound	Application rate (oz per 1000 ft ²)	Exposure (ug/kg/hr)		Estimated Exposure to Aliette® Respiratory	Reference
		Dermal	Respiratory		
Benomyl	0.35	26	0.63	3.5 x 10 ²	3
Benomyl	0.43	34	1.1	3.8 x 10 ²	3
Cycloheximide	1.0	4.3	0.91	21	3
Cadmate	0.46	228	0.45	2.4 x 10 ³	3
Benomyl	0.70	104	0.79	7.1 x 10 ²	3
Cycloheximide	1.48	1.7	0.63	5.5	3
Cadmate	0.38	27	0.63	3.4 x 10 ²	3
Thiophanate	0.23	0	0	0	3
Trichlorfon	2.0	4.1	0	9.8	3
Thiophanate	0.8	70	0	4.2 x 10 ²	3
Carbaryl	3.9	1296	0	1.6 x 10 ³	3
PCNB	0.5	47	0	4.5 x 10 ²	4
2, 4-D	0.44	0.86	0	9.4 x 10 ³	2
MEAN				1.2 x 10 ³	3.5

3.2 Mixer/loaders

Aliette® is to be applied at a mean rate of 4.8 oz per 1000 ft². If a single worker mixes/loads all of the material for test sites within a state, the total amount mixed per year would be:

$$\begin{aligned} \text{Aliette}^{\circledR} \text{ mixed} &= \frac{4.8 \text{ oz}}{1000 \text{ ft}^2} \times \frac{1.8 \times 10^5 \text{ ft}^2}{\text{year}} \\ (\text{oz/yr}) & \\ &= 8.6 \times 10^2 \text{ oz mixed/year} \end{aligned}$$

The mean dermal exposure of mixer/loaders preparing 2,4-D was 5.3 ug/kg/oz mixed (2). The annual exposure of a mixer/loader would be:

$$\begin{aligned} \text{Annual dermal exposure} &= 5.3 \text{ ug/kg/oz} \times 8.6 \times 10^2 \text{ oz/year} \\ (\text{ug/kg/yr}) & \\ &= 4.6 \times 10^3 \text{ ug/kg/yr} \end{aligned}$$

The surrogate studies, except the BAAL study, did not separate mixer/loader exposure from that of the applicator. It was not clear whether separate individuals performed these tasks. EAB realizes that part of the applicator exposure may be due to the mixing/loading procedure and therefore the applicator exposures might be slightly overestimated.



David Jaquith
Special Review Section
Exposure Assessment Branch
Hazard Evaluation Division

References

- (1) Davis, J.E. (1980) Minimizing Occupational Exposure to Pesticides: Personnel Monitoring, Residue Reviews, Vol 75, pp 33-50.
- (2) British Agrochemicals Association Limited (1984) Spray Operator Safety Study. British Agrochemicals Association Limited, London.
- (3) Daniel, WH, Freeborg, RP, and Konopinski, VJ (1980) Evaluation of the Utilization of RPAR'D Pesticides Applied to Recreational Turf. Unpublished report prepared for the North Central Regional Pesticide Impact Assessment Program.
- (4) Daniel, WH, Freeborg, RP, and Konopinski, VJ (1982) Personnel Exposure to PCNB and Contaminant HCB During Application to Both Golf Courses and Residential Sites. Unpublished report prepared for the North Central Regional Pesticide Impact Assessment Program.
- (5) Memo from E. N. Pelletier (BUD) to D. Jaquith (EAB) titled "Use Exposure Report for Proposed Applications of Aliette to Turf Grasses, dated 6/3/85.