7605 / Linuron 3-14-85

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To: I. Sunzenauer
Product Manager #78
Registration Division (TS-767C)

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

Attached please find the EAB review of...

Reg./File No.: _____

Chemical: Linuron

Type Product: Herbicide

Product Name: Lorox

Company Name: Du Pont

Submission Purpose: Aerial Applicator Exposure Assessment

ACTION CODE: 827

Date In: 2/13/85

EAB # 5274

Date Completed: 3/14/85

TAIS (level II) Days

14

Deferrals To:

_____ Ecological Effects Branch

_____ Residue Chemistry Branch

_____ Toxicology Branch

1/6

1.0 INTRODUCTION

An exposure assessment has been conducted in response to the request by E. I. du Pont de Nemours & Co., Inc. to reinstate aerial use on the Lorox and Lorox L labels. Lorox and Lorox L are herbicides that contain linuron, a chemical currently under special review by the Agency. Exposure estimates were calculated for mixer/loaders, pilots, and flaggers based on surrogate data available in the literature.

Aerial use of linuron is proposed for asparagus, carrots, potatoes, soybeans, and wheat. BUD has determined that carrots are the only site of consequence related to aerial application of linuron. This assessment will therefore be restricted to aerial use on carrots.

2.0 ASSUMPTIONS

In conducting the exposure assessment, EAB has made several assumptions.

1) The average worker weighs 70 kg.
2) The different tasks (mixing/loading, piloting, and flagging) will be performed by seperate individuals.
3) No difference in exposure to mixer/loaders using a closed versus open loading system will occur. A review of exposure studies investigating exposure to workers using the two types of loading systems has not conclusively indicated that the closed loading system affords greater protection than the open system. Although a closed system will theoretically reduce mixer/loader exposure, variations in equipment efficency and individual worker habits appear to have greater impacts on mixer/loader exposure potential. Therefore for the purpose of this assessment, the type of loading system was ignored.
4) Adjustment of worker exposure to account for the use of protective clothing was not performed. Published literature generally does not include sufficent information to permit such adjustments. To account for the label requirement that mixer/loaders must wear chemical resistant gloves, surrogate data in which the mixer/loaders wore gloves were used.
5) Adjustment of worker exposure for dermal penetration was not done. EAB defers to the Toxicology Branch to determine dermal absorption.

3.0 SUMMARY OF SURROGATE STUDIES

3.1 Maddy et al (1) monitored the dermal and respiratory exposure of mixer/loaders, pilots, and flaggers involved in spraying crops with phosdrin. Phosdrin was applied at an average application rate of 0.58 lbs a.i./acre by fixed wing aircraft. The mixer/loaders wore long sleeve overalls, heavy rubber gloves, and rubber boots. The spray tanks were loaded using a closed system. The pilots wore long pants

and long sleeve shirts and the flaggers wore overalls and long sleeve shirts. Exposure was measured using gauze patches attached to exposed skin and skin protected by clothing, hand washes, and a personal air sampler. Four replicates were measured for the mixer/loaders and the pilots. Eight replicates were measured for the flaggers. The estimated exposures (ug/kg/hr) were as follows:

JOB	DERMAL		RESPIRATORY	
	Range	Mean	Range	Mean
M/L	0.63-2.5	1.5	0.06-0.31	0.18
Pilot	0.0-0.59	0.19	0.09-0.37	0.21
Flagger	0.0-18	2.6	0.0 -1.6	0.30

3.2 Knarr et al.(2) estimated the dermal and respiratory exposure of workers applying Ordam 8E (molinate) to rice. The reference did not state the application rate; however, the Ordam 8E label indicates that molinate should be applied at the rate of 4 pts/ acre. Ordam 8E contains 8 lbs a.i./gallon which would yield an application rate of 4 lbs a.i./acre. Exposure was monitored using gauze patches both above and under the clothing, hand rinses, and personal air samplers. The workers wore overalls and it is assumed gloves. The estimated exposures (ug/kg/hr) were as follows:

JOB	DERMAL	RESPIRATORY
M/L	2,900	1.1
Pilot	0.44	0.23
Flagger	97	4.3

3.3 Lavy et al.(3) conducted a study to measure the exposure of workers to the aerial application of 2,4-D in forests. The 2,4-D was applied at an application rate of 2 lbs a.i./acre. The workers wore normal working clothes. This is assumed to be long pants, short sleeved shirt, and a hat. In addition, the mixer/loaders wore rubber gloves. Dermal exposure to two mixer/loaders utilizing a closed system was (7.7 and 680 ug/kg/hr) 340 ug/kg/hr. The transfer pump for a third mixer/loader failed and the spray tanks were manually loaded by pail. The dermal exposure to the third mixer/loader was 460 ug/kg/hr. Dermal exposure to the pilots averaged 13 ug/kg/hr. Respiratory levels of 2,4-D for all workers was below the detection limit of 0.05 ug 2,4-D on the XAD-2 resin.

3.4 Peoples et al.(4) measured the exposure of pilots and flaggers to DEF and Folex. The DEF and Folex were aerially applied to cotton fields at application rates of 1.32 and 1.5 lbs a.i./acre, respectively. The flaggers wore overalls and caps; the pilots wore ordinary clothing. The estimated exposures (ug/kg/hr) were as follows:

CHEMICAL	JOB	DERMAL		RESPIRATORY	
		Range	Mean	Range	Mean
DEF	Pilot	10 - 40	20	0.1 - 2	0.7
	Flagger	3 -200	40	0.3 -20	4
Folex	Pilot	10 - 20	20	0.1 - 0.2	0.1
	Flagger	2 - 80	40	0.4 - 3	2

3.5 Maitlen et al.(5) measured the dermal exposure of mixer/loaders, pilots, and flaggers to aerially applied Sevimol 4, a liquid suspension containing 40% carbaryl. The carbaryl was applied to corn at 2 lbs a.i./acre. The exposure to mixer/loaders was 49 ug/kg/hr with gloves and 570 ug/kg/hr when gloves were not worn. The pilots had an exposure of 380 ug/kg/hr; however, they also adjusted the spray nozzles. If hand exposure is excluded, the dermal exposure would be 11 ug/kg/hr. The estimated exposure to the flaggers was 5,500 ug/kg/hr.

4.0 CALCULATION OF LINURON EXPOSURE

4.1 Adjustment of surrogate application rates to 1 lb a.i./acre
So that the surrogate data may be used to estimate linuron exposure, the surrogate exposures are adjusted to a 1 lb a.i./acre application rate.

Mixer/Loaders (dermal):

Phosdrin-	1.5 ug/kg/hr x 1.0/0.58 = 2.6 ug/kg/hr
Ordam 8E-	2,900 ug/kg/hr x 1.0/4.0 = 730 ug/kg/hr
2,4-D-	340 ug/kg/hr x 1.0/2.0 = 170 ug/kg/hr
2,4-D-	460 ug/kg/hr x 1.0/2.0 = 230 ug/kg/hr
Sevimol 4-	49 ug/kg/hr x 1.0/2.0 = 25 ug/kg/hr

Mean = 230 ug/kg/hr

Mixer/Loaders (Respiratory):

Phosdrin-	0.18 ug/kg/hr x 1.0/0.58 = 0.31 ug/kg/hr
Ordam 8E-	1.1 ug/kg/hr x 1.0/4.0 = 0.28 ug/kg/hr

Mean = 0.30 ug/kg/hr

Pilots (Dermal):

Phosdrin-	0.19 ug/kg/hr x 1.0/0.58 = 0.33 ug/kg/hr
Ordam 8E-	0.44 ug/kg/hr x 1.0/4.0 = 0.11 ug/kg/hr
2,4-D-	13 ug/kg/hr x 1.0/2.0 = 6.5 ug/kg/hr
DEF-	20 ug/kg/hr x 1.0/1.32 = 15 ug/kg/hr
Folex-	20 ug/kg/hr x 1.0/1.5 = 13 ug/kg/hr*
Sevimol 4-	11 ug/kg/hr x 1.0/2.0 = 5.5 ug/kg/hr

Mean = 6.7 ug/kg/hr

* Excludes hand exposure. Pilots adjusted nozzles.

Pilots (Respiratory):

Phosdrin-	0.21 ug/kg/hr x 1.0/0.58 = 0.36 ug/kg/hr
Ordam 8E-	0.23 ug/kg/hr x 1.0/4.0 = 0.06 ug/kg/hr
DEF-	0.7 ug/kg/hr x 1.0/1.32 = 0.53 ug/kg/hr
Folex-	0.1 ug/kg/hr x 1.0/1.5 = 0.07 ug/kg/hr

Mean = 0.26 ug/kg/hr

Flaggers (Dermal):

Phosdrin-	2.6 ug/kg/hr x 1.0/0.58 = 4.5 ug/kg/hr
Ordam 8E-	97 ug/kg/hr x 1.0/4.0 = 24 ug/kg/hr
DEF-	40 ug/kg/hr x 1.0/1.32 = 30 ug/kg/hr
Folex-	40 ug/kg/hr x 1.0/1.5 = 27 ug/kg/hr
Sevimol 4-	5,500 ug/kg/hr x 1.0/2.0 = 2800 ug/kg/hr

Mean = 580 ug/kg/hr

Flaggers (Respiratory):

Phosdrin-	0.30 ug/kg/hr x 1.0/0.58 = 0.52 ug/kg/hr
Ordam 8E-	0.23 ug/kg/hr x 1.0/4.0 = 0.06 ug/kg/hr
DEF-	4 ug/kg/hr x 1.0/1.32 = 3.0 ug/kg/hr
Folex-	2 ug/kg/hr x 1.0/1.5 = 1.3 ug/kg/hr

Mean = 1.2 ug/kg/hr

4.2 Carrots

The majority of aerial application to carrots occurs in Florida and the lower San Joaquin Valley. Florida shall be examined as a typical example.

In Florida there is usually one preemergence and two post emergence aerial treatments at an application rate of 0.5 lbs a.i./acre. An average of 200 acres are treated per day during a 2 hour time span. The custom applicators also work 1 to 2 days/week for 6 to 7 months of the year. One to two mixer/loaders and one pilot work on one team. Flaggers are not used (6). This data yields a yearly work time of (2 hrs/day x 1.5 days/wk x 4.3 wks/month x 6.5 months/yr) 84 hours/yr.

Mixer/Loaders: 230 ug/kg/hr at 1 lb a.i./acre x 0.5 lbs linuron/acre = 120 ug/kg/hr

Daily Exposure- 120 ug/kg/hr x 2 hrs/day = 230 ug/kg/day
230 ug/kg/day ÷ 1.5 persons = 150 ug/kg/day

Yearly Exposure- 120 ug/kg/hr x 84 hr/yr = 9700 ug/kg/yr
9700 ug/kg/yr ÷ 1.5 persons = 6400 ug/kg/yr

Pilots: 7.0 ug/kg/hr at 1 lb a.i./acre x 0.5 lbs linuron/acre = 3.5 ug/kg/hr

Daily Exposure- 3.5 ug/kg/hr x 2 hrs/day = 7.0 ug/kg/day

Yearly Exposure- 3.5 ug/kg/hr x 84 hr/yr = 290 ug/kg/yr

Curt Lunchick

Curt Lunchick, Chemist
Special Review Section
Exposure Assessment Branch
Hazard Evaluation Division (TS-769C)

REFERENCES

1. Maddy,KT et al. (1982) Monitoring of Potential Occupational Exposure of Mixer/Loaders, Pilots, and Flaggers During Application of Phosdrin (Mevinphos) in Imperial County in 1981. Report HS-889, Worker Health and Safety Unit, California Department of Food and Agriculture. 34 pages.

2. Knarr,RD et al. (1982) Worker Exposure During Application of a Liquid and Granular Formulation of a Herbicide. Text of presentation at Fall 1982 American Chemical Society meeting.

3. Lavy,TL et al. (1982) 2,4-D Exposure Received by Aerial Application Crews During Forest Spray Operations. J. Agric. Food Chem. 30:375-381.

4. Peoples,SA et al. (1981) Monitoring of Potential Exposures of Mixer/Loaders, Pilots, and Flaggers During Application of Tributyl Phosphorotrithioate (DEF) and Tributyl Phosphorotrithioite (Folex) to Cotton Fields in the San Joaquin Valley of California in 1979. Report HS-676, Worker Health and Safety Unit, California Department of Food and Agriculture. 21 pages.

5. Maitlen,JC et al. (1982) Workers in the Agricultural Environment: Dermal Exposure to Carbaryl. Pesticide Residues and Exposure, American Chemical Society. pp 83-103.

6. Szuhay,D. Transmittal of Biological Data for the Exposure Assessment in the Aerial Application of Linuron to Carrots. Memorandum of 4 March 1985 to Curt Lunchick.