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D-7653 / Linuron SR

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To: R. Taylor
Product Manager #25
Registration Division (TS-767C)

From: Joseph C. Reinert, Ph.D., Chief
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Attached please find the EAB review of...

Reg./File No.: 352-326

Chemical: Linuron

Type Product: Herbicide

Product Name: Lorox L

Company Name: Du Pont

Submission Purpose: Review exposure data

ZBB Code: ?

Date In: 10/12 & 10/25/84

Date Completed: 10/31/84

ACTION CODE: 600 & 601

EAB # 5005 & 5037

TAIS (level II)	Days
22	5

Deferrals To:

_____ Ecological Effects Branch

_____ Residue Chemistry Branch

_____ Toxicology Branch

1.0 INTRODUCTION

Du Pont has submitted an evaluation of potential exposure to farm workers from the use of Lorex® L (linuron) as a herbicide on soybeans. For the PD 1, occupational exposure to linuron was was estimated based on an exposure assessment for alachlor. Since a more rigorous assessment is required for a PD 2/3, an exposure assessment specific for linuron will be prepared.

2.0 METHOD

The occupational exposure of mixer/loaders and applicators was estimated using data collected from three field studies in which Lorox L was applied to soybeans by ground boom spray. Lorox L is a liquid herbicide containing 4 lbs of the active ingredient linuron per gallon. Mixer/loaders #1 and #2 each loaded one tank with 11.25 gallons of Lorox L. Mixer/loader #3 loaded four tanks with a total of 15 gallons of Lorox L.

Applicators #1 and #2 each sprayed two fields of 30 and 15 acres each for a total of 45 acres. Lorox L was applied at the rate of 2 pints/acre (1 lb. a.i./acre) and 20 gallons per acre. The third applicator applied Lorox L to 110 acres at the application rate of 1 pint Lorox L per acre (0.5 lbs. a.i./acre) and 20 gallons per acre.

Respiratory exposure for all workers was measured by placing a glass tube containing polyurethane, gauze, and filter paper under the chin. A pump pulled 2 liters of air per minute through the glass tube. Dermal exposure was measured by placing cotton gloves on the hands and 4" x 4" filter paper backed cotton gauze patches on each shoulder, the forearms, the lower legs, back, chest, and thighs. Patches were also placed under the sleeve cuffs of the short sleeve shirts and on the chest under the shirt. All patches and the polyurethane were preextracted to remove linuron residues. The applicators and mixer/loaders wore long pants and short sleeve shirts.

The samples were analyzed for linuron content by liquid chromatography with a detection limit of 50 ng/sample. Each cotton gauze patch had a 2" x 2" center cut out which was analyzed. The specific analytical procedures were detailed in the Du Pont report. The report did not specifically state that recovery standards and stability were determined; however, the methods were based on the methodology detailed in "Search for Linuron Residues in Tributaries of the Chesapeake Bay" [Zahnow,EW and Riggleman, JD. J. Agric. Food Chem. 28(5):974] and the recovery data were submitted seperately at the request of EAB under Reg./File No. 352-326.

The proposed labeling for Lorox L requires the use of wide-brimmed hats, heavy-duty fabric work gloves, and one piece overalls with long sleeves and long pants as protective

clothing. EAB assumed that these protective clothing precautions if followed would provide 80% protection to all covered areas of the body and 90% protection to the hands. EAB also assumed that 100 acres of soybeans per day is the maximum area to which linuron is applied and that an applicator may apply linuron to 600 acres per year. The 100 acres is the size of an average farm and approximately the maximum acreage that can be sprayed by one applicator per day. The 600 acres are the assumed maximum acreage that can be treated by one applicator in the time period permitted for growers to complete the planting operation. The maximum application rate is 4 lbs a.i./acre for the 4% of soybean acreage in which post-emergence spraying is done and 3.0 lbs a.i./acre for the 96% of the acreage in which only pre-emergence spraying is done (Track A. Biological Data Base for Current Benefits of Linuron Herbicide. 30 March 1984). The estimated linuron exposure was that quantity of linuron estimated to have impinged on the skin and did not consider dermal absorption.

3.0 RESULTS

The estimated linuron dermal exposure for mixer/loaders ranged from 0.09 to 0.31 ug/kg/lb. active ingredient mixed. Respiratory exposure was insignificant when compared to dermal exposure. The estimated exposure for mixing/loading 100 lbs of linuron to apply to 100 acres ranged from 8.9 to 31 ug/kg/day. Mixer/loader exposure data are presented in Table 1.

Applicator dermal exposure to linuron was estimated to range from 0.67 to 0.89 ug/kg/hr and 3.2 to 4.3 ug/kg per 4.8 hour day. The leg and thigh pads of applicator #3 were found to contain over 1000 times the quantity of linuron that was found on the other applicators. Du Pont stated that the large amounts of linuron found on the patches may have resulted from the applicator rubbing the patches against the saddle tanks of the rig. EAB believes this explaination to be plausible and substituted the average of the leg exposures for applicators #1 and #2 for applicator #3. Respiratory exposure among the applicators was determined to be insignificant compared to dermal exposure. Applicator exposure data are presented in Table 2.

Analysis on gauze patches fortified with 0.05 to 300 ug of linuron determined a mean recovery of 97%. The analysis of cotton gloves fortified with 5.0 to 10,000 ug linuron determined a mean recovery of 90%.

Summaries of the annual and annualized daily exposures of the mixer/loaders, applicators, and for combined activities are presented in Table 3. The estimated exposures were calculated for pre-emergence use only and for both pre- and post-emergence use.

TABLE 1. MIXER/LOADER EXPOSURE TO LINURON (ug)

	M/L #1	M/L #2	M/L #3	Mean
Pints Lorox L Loaded	90	90	120	
Lbs. Linuron Loaded	45	45	60	
Face[a]	1.3	2.3	12	
Forearms*	0.51	0.61	48	
Lower Legs*	12	0.92	310	
Back of Neck	0.21	0.21	0.81	
"V" of Chest	0.29	0.29	17	
Thighs*	2.4	0.87	300	
Upper Arms*	0.82	0.52	0.52	
Chest*	1.4	1.4	82	
Back*	1.4	1.4	5.2	
Hands†	970	270	130	
Total Exposure	990	280	900	720
ug/lb a.i.	22	6.2	15	14
ug/kg/lb a.i.[b]	0.31	0.09	0.2	0.21

[a] Exposure per body area = ug linuron on the patch ÷ 25.81 cm^2/patch x cm^2 body area. Body area based on body surface areas calculated by Durham and Wolfe (1962).

[b] Assumes body weight of 70 kg.

* Values presented include assumption that protective clothing reduced exposure by 80%.

† Values presented include assumption that gloves reduced exposure by 90%.

TABLE 2. APPLICATOR EXPOSURE TO LINURON (ug)

	Appl. #1	Appl. #1	Appl. #2	Appl. #2	Appl. #3	Mean
Acres Treated	30	15	30	15	110	
Application Rate(pts/acre)	2	2	2	2	1	
Exposure Time (min)[a]	-	49	-	45	590	
Face[b]	5.4	6.0	1.3	7.3	36	
Forearms*	2.1	1.2	0.47	1.5	76	
Lower Legs*	4.0	1.3	1.1	1.3	110	
Back of Neck	0.68	0.43	0.21	0.81	13	
"V" of Chest	0.29	0.29	0.29	0.76	9.0	
Thighs*	3.3	3.6	0.96	2.5	67[c]	
Upper Arms*	1.4	0.51	0.51	0.56	2.1	
Chest*	1.4	1.4	1.4	3.6	42	
Back*	4.4	2.6	1.4	5.2	81	
Hands†	7.4	3.2	0.57	3.0	42	
Exposure/Field	30	21	8.2	27	480	
Total Exposure		51		35	480	
ug/hr		62		47	49	53
ug/kg/hr[d]		0.89		0.67	0.70	0.75
ug/kg/day[e]		4.3		3.2	3.3	3.6

[a] Time is the total time required for the applicator to complete all fields.

[b] Exposure per body area = ug linuron on patch ÷ 25.81 cm^2 per patch x body surface area. Body surface area derived by Durham and Wolfe (1962).

[c] Sample contaminated. Average of first and second applicators used. (3.3+3.6+0.96+2.5)/2 x (590 min/45 min) = 67.

[d] Body weight assumed to be 70 kg.

[e] Work day assumed to be 4.8 hours.

* Values presented include assumption that protective clothing reduced exposure by 80%.

† Values presented include assumption that gloves reduced exposure by 90%.

TABLE 3. CALCULATION OF MAXIMUM ESTIMATED EXPOSURE TO LINURON

1. Mixer/Loader Exposure-For 4% of acreage in which post-emergence application is conducted.

   Average exposure = 0.21 ug/kg/lb a.i.
   Maximum lbs a.i./600 acres/yr = 4.0 lbs a.i./acre x 600 acres = 2400 lbs a.i.
   Maximum annual exposure = 0.21 ug/kg/lb a.i. x 2400 lbs a.i. = 500 ug/kg/yr
   Maximum annualized daily exposure = 500 ug/kg/yr ÷ 365 days/yr = 1.4 ug/kg/day

2. Mixer/Loader Exposure- For 96% of acreage in which only pre-emergence application is conducted.

   Average exposure = 0.21 ug/kg/lb a.i.
   Maximum lbs a.i./600 acres/yr = 3.0 lbs a.i./acre x 600 acres = 1800 lbs a.i.
   Maximum annual exposure = 0.21 ug/kg/lb a.i. x 1800 lbs a.i. = 380 ug/kg/yr
   Maximum annualized daily exposure = 380 ug/kg/yr ÷ 365 days/yr = 1.0 ug/kg/day

3. Pre-emergence Applicator Exposure.

   Average exposure at application rate of 1 lb a.i./acre = (4.3 ug/kg/day + 3.2 ug/kg/day)/2 = 3.8 ug/kg/day
   Conversion rate = 3.0 lbs a.i./acre ÷ 1.0 lbs a.i./acre = 3
   Average daily exposure = 3.8 ug/kg/day x 3 = 11 ug/kg/day
   If 100 acres treated per day and 600 acres treated per year the-
   Maximum annual exposure = 11 ug/kg/day x 6 days/yr = 68 ug/kg/yr
   Maximum annualized daily exposure = 68 ug/kg/yr ÷ 365 days/yr = 0.19 ug/kg/day

4. Post-emergence Applicator Exposure.

   Average exposure at application rate of 1 lb a.i./acre = 3.8 ug/kg/day
   Post-emergence application rate = 1 lb a.i./acre
   Maximum annual exposure = 3.8 ug/kg/day x 6 days/yr = 23 ug/kg/yr
   Maximum annualized daily exposure = 23 ug/kg/yr ÷ 365 days/yr = 0.06 ug/kg/day

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SUMMARY OF ESTIMATED EXPOSURE TO LINURON

	Pre-emergence Use Only		Pre- and Post-emergence Use	
	ug/kg/yr	ug/kg/day[1]	ug/kg/yr	ug/kg/day[1]
Mixer/Loader	380	1.0	500	1.4
Applicator	68	0.19	91	0.25
Combined	450	1.2	590	1.7

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1 Annualized Daily Exposure- ug/kg/day = ug/kg/yr ÷ 365 days/yr.

4.0 DISCUSSION

The methodology employed by Du Pont to estimate mixer/loader and applicator exposure to linuron was consistent with acceptable practices. EAB objected to the ommission of the exposure of the back and chest under the clothing in the Du Pont calculations. EAB utilized the back and chest patches above the clothing to calculate exposure to the torso before correcting for 80% exposure reduction which was estimated to result from the proposed label requirements. Three replicates were used for the mixer/loaders and the applicators. This number of replicates is minimally acceptable. However, EAB prefers more replicates than three.

5.0 RECOMMENDATIONS

EPA no longer recommends the use of heavy-duty fabric work gloves as a means of hand protection. The fabric gloves trap the pesticides and are therefore difficult to decontaminate after use. The gloves described on the label would be more appropriately defined as protective gloves. Currently research is being conducted to determine the degree of protection afforded by different materials. Dr. Norm Henry is involved in the ASTM Glove Testing Program at Du Pont's Haskell Laboratories. Any glove protection data specific for linuron that might be submitted to EAB by Du Pont will be evaluated for its applicability in future exposure assessments conducted by EAB.

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