UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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OFFICE OF
PESTICIDES AND TOXIC SUBSTANCES

MEMORANDUM

TO: John Doherty
Toxicology Branch (TS-769)
Hazard Evaluation Division

Thru: Joseph C. Reinert, Chief
Exposure Assessment Branch, Section #2
Hazard Evaluation Division

The following exposure assessment for cotton field applicators was conducted in response to a request by the Toxicology Branch (January 12, 1984 memorandum from John Doherty to David Severn, Chief, Exposure Assessment Branch, Hazard Evaluation Division). The registration application is being forwarded to the Agency jointly by FMC and ICI. The FMC formulated product is called called Ammo and the ICI, is called Cymbush. I have reviewed the confidential statements of formula currently available in Residue Chemistry Branch File IG2461 and have found no indication that the technical product contains inerts which are related to the parent chemical.

Use information relative to exposure is provided by Bill Gross of the Science Support Branch, Benefits and Use Division (Feb. 1, 1984 memorandum to David Severn). Gross identifies 10 different scenarios which would be expected to incur appreciably different exposures. These are:

Worker
ID # Description of Work (Abbreviated Description of Work)

1. Mixing Ammo® with water for aerial application and loading it into the airplane (Mixing/Loading/Ammo®/Water/Aerial).

2. Pilot applying Ammo® in water (Pilot/Ammo®/Water).

3. Mixing Ammo® with oil for aerial application and loading it into the airplane (Mixing/Loading/Ammo®/oil/Aerial).

4. Pilot applying Ammo in oil (Pilot/Ammo®/oil)

5. Mixing/loading Ammo® with water for ground application. (Ground/Mixing/Loading/Ammo/Water).

6. Ground application of Ammo® in water by tractor (Ground/Application/Ammo®/Water).

7. Mixing/Loading Cymbush® with water for ground application. (Ground/Mixing/Loading/Cymbush/Water)

8. Ground Application of Cymbush® in water (Ground/Cymbush Water).

9. Mixing Cymbush® with water for aerial application and loading it into the airplane (Mixing/Loading/Cymbush®/Water/Aerial).

10. Pilot applying Cymbush® in water (Pilot/Cymbush®/Water).

Discussions of the assumptions used in the worker exposure calculations and summaries of the results of these calculations can be found below. References to the 10 different occupations may be in the form of the worker ID# or the abbreviated description of work.

Surrogate data values (exposures per hour or exposures per pound of active ingredient handled) were originally cited in my expanded applicator Exposure Table and Documentation for the Amitrole Registration Standard (18 Oct. 1983 memorandum to John Tice, Science Integration Staff).

II. General Assumptions

1. All workers are unprotected: wearing cotton work clothes, short-sleeved shirt, without hat, gloves or respirator, with 15 percent of the body surface uncovered by clothing.

2. Applicator exposure was calculated from surrogate data by two methods. In the first and preferred method amitrole exposure varies as a linear function of the pounds of amtrole active expected to be used vs. the pounds of applied surrogate active ingredient. When data were unavailable to drive calculations by the preferred method, applicator exposure was calculated as a linear function of the duration of application and the concentration of the active ingredient in the spray.

3. For mixer/loaders, exposures to cypermethrin, versus those determined for the surrogate were considered to be proportional to the ratio of the poundage of active ingredient handled daily in the surrogate study versus the daily use rate of cypermethrin projected by BUD.

4. It is assumed that applicators working from tractors do their own mixing and loading.

5. On advice from William Gross (BUD), it is assumed that flaggers are not necessary for aerial application.

6. Ranges for my exposure estimates reflect the ratios of the high and low observations in the surrogate study to the mean values in those studies. For example, if a the highest observed exposure in a surrogate study was twice the mean value, then my high range would be twice the typical case (see table 1).

III. Specific Assumptions

1. Mixing Ammo® with water for aerial application and loading it into the airplane (Mixing/Loading/Ammo®/Water/Aerial).

BUD indicates that 262 mixer/loaders support 1,225,000 acre-treatments and that an average of 0.08 lbs a.i. are applied per acre. BUD further estimates that treatment is at the rate of 1260 acres per day indicating that the mixer/loaders work a total of only 972 man days total or about 4 days per year on the average. Each mixer/loader, therefore, handles about 100 lbs/day (1260 x 0.08) on the average.

Surrogate mixer/loader data are provided in Dubelman et al. (1982). This study indicated that a conventional tank fill would cause a dermal exposure of 2.44 mg and an inhalation exposure of 1.44×10^{-5} mg for every pound of active ingredient loaded. The estimate of typical daily dermal exposure is, therefore, ap. 240 mg/day or 100 x 2.44. Similarly the estimate of typical inhalation exposure is negligible as $100 \times 1.44 \times 10^{-5}$ is only 0.00144. My "ranges" in Table 1 are calculated from the range of observations in the surrogate study. Dermal residues observed during the Dubelman et al. (1982) study diverged from the average by a factor of 0.02 on the lower end and 4.77 on the high end. This range does not include the hand residues (The "typical" exposure estimates do reflect hand residue.) as the individual observations which include hand residues were not immediately available. I am assuming that the scatter of the values without hand residues would be representative of the scatter with hand residues.

2. Pilot applying Ammo® in water (Pilot/Ammo®/Water).

BUD estimates that there are 262 Ammo Aerial applicators

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and that they apply Ammo at 0.08 lbs a.i./acre in 2 gallons of water on the average (Average spray mix ap. 0.5% assuming water weighs 8.3 lbs/gal. Like the mixer/loaders they work an average of 4 days per year, but they are exposed 4.5 hrs./day. Surrogate data for aircraft pilot exposure are provided by Jegier (1964, p. 673)*. In this study of endrin application (spray mix 7.2%), it was determined that pilots were subject to a mean respiratory exposure of 0.08 mg hr. (range: 0.02-0.14) mg/hr.) and a mean dermal exposure of 1.18 mg/hr range: 0.88-1.64 mg/hr.) Prorating the daily cypermethrin from the surrogate data by the relative spray mix concentration and the ratio of the number of hours worked per day I derive an estimate of ap. 0.37 mg/dy dermally (4.5 hr/dy x 0.5%/7.2% x 1.18 mg/hr = 0.37mg/dy). The lowest and highest dermal observations compare to the mean by factors of 0.7 and 1.38. The observed respiratory exposure extremes differed from the mean by factors of 0.25 and 1.75.

3. Mixing Ammo® with oil for aerial application and loading it into the airplane (Mixing/Loading/Ammo®/oil/Aerial).

   See Section IV.

4. Pilot applying Ammo® in oil (Pilot/Ammo®/oil).

   See Section IV.

5. Mixing/loading Ammo® with water for ground application. (Ground/Mixing/Loading/Ammo/Water).

Surrogate mixer/loader data are provided in Dubelman et al. (1982). This study indicated that a conventional tank fill would cause a dermal exposure of 2.44 mg and an inhalation exposure of 1.44×10^{-5} mg for every pound of active ingredient loaded. BUD estimates that the average farmer treats 81 acres per day. If he mixes and loads his own spray mix, then he must handle approximately 6.5 lbs/a.i./day (0.08 x 81 pounds of active each day. I estimate that a typical daily dermal exposure would, therefore, be ap. 16mg (6.5 lbs a.i./dy x 2.44 mg = ap. 16 mg). If he treats the average farm (237) acres 9 times (2133 acre-treatments) then he must work approximately 26 days per year.

Additional uncertainty is introduced by the range of observations in the surrogate study. Dermal residues observed during the Dubelman et al. (1982) study diverged from the average by a factor of 0.02 on the lower end and 4.77 on the high end. This range does not include the hand residues, which were not immediately available. Presumably the observed values without hand residues would be representative, however. Inhalation observations differed from the average by a factor of 0.152 on the lower end and 1.54 on the higher. The ranges of observed values appear in J. Jensen's 12 Jan 81 review of Monsanto Report No. MSL-1150.

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6. Ground application of Ammo® in water by tractor (Ground/Application/Ammo®/Water).

BUD estimates that the average farm size is 237 acres and that the farm is treated nine times per year. This indicates that the ground application occurs approximately 26 days per year ((237 x 9)/81)). Each day the farmer applies approximately 6.5 lbs. a.i. (0.08 x 81). He works approximately 26 days per year (see assessment #5).

Surrogate data for applicator exposure on a "poundage applied" basis are available from an article on diallate by Dubelman et al. (1982). These investigators indicate that 2.54×10^{-4} mg/lb a.i. and 5.3×10^{-3} mg/lb a.i. would be appropriate estimates of the respective inhalation and dermal exposures for every pound of active ingredient applied. The average daily exposure, based on the pounds per acre are therefore, 0.03 mg ($52 \times 5.3 \times 10^{-3}$) dermally and ap. .002 mg ($6.5 \times 2.54 \times 10^{-4}$) by inhalation.

A range of uncertainty is projected from the surrogate data. The range for EPN applicator exposure estimates during the Dubelman study is taken from Janice Jensen's 1/12/81 review of Monsanto report No. MSL-1150*. The dermal exposures to individual applicators ranged from a factor of 0.18 to 2 when compared to the average. When compared in the same manner, the inhalation exposures deviated from the average by a factor of .18 on the low end and by a factor of 2.9 on the high end*.

*The review of Monsanto Report No. MSL-1150 (which was Dubelman's raw data) combines the boom spray and spray harrow applicator exposure data. It is assumed that the range of exposures due to these two application techniques would be similar. The typical exposure is based on the exposure due to boom spraying only but the raw data for boom spraying alone were not readily available.

7. Mixing/Loading Cymbush® with water for ground application. (Ground/Mixing/Loading/Cymbush/Water)

   All assumptions and parameters are the same for Cymbush® as they were for Ammo®. The daily and yearly exposures are therefore the same.

8. Ground Application of Cymbush® in water (Ground/Cymbush Water).

   All assumptions and parameters are the same for Cymbush® as they were for Ammo®. The daily and yearly exposures are therefore the same.

9. Mixing Cymbush® with water for aerial application and loading it into the airplane (Mixing/Loading/Cymbush®/Water/Aerial).

   While BUD projects that more acreage may be treated with Cymbush in water than with Ammo in water (draft memoradum from Bill Gross, BUD, the individual mixer/loader exposure is the same.

10. Pilot applying Cymbush® in water (Pilot/Cymbush®/Water).

    While BUD projects that more acreage may be treated with Cymbush in water than with Ammo in water (draft memoradum from Bill Gross, BUD) the individual applicator loader exposure is the same.

IV. Results and Conclusions

The Exposure Assessment Branch has no surrogate data for pesticides which have been aerially applied in oil. It is recommended that a field study be submitted to the Agency prior to further consideration of registration applications involving Ultra Low Volume (ULV) application of cypermethrin in oil. Of particular concern is the possibility that exposures to humans due to this use may differ substantially from the exposures expected for aqueous spray mixes. Reasons that the exposure might be different are possible changes in the spray equipment, possible changes in the cockpit air filtering system, and different dispersion of the oil droplets due to their low specific gravity. For all other scenarios projected exposures are shown in table 1.

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The label should note that flaggers should not be used for aerial application of aqueous cypermethrin spray mixes. BUD has indicated that flaggers are not necessary and no exposure assessment has, therefore, been conducted. (Additionally it is noted that cypermethrin is an eye and skin irritant which could be harmful to flaggers).

V. Acknowledgements

I am grateful to Robert Holst (EAB/HED) for his advice regarding ULV oil application and to William Gross for reviewing this document for consistency with the BUD use data.

Robert K. Hitch
Section #2
Exposure Assessment Branch/HED

Table 1. CYPERMETHRIN APPLICATOR EXPOSURE ESTIMATE
(no Special Protective Clothing Assumed)

	Daily Exposures (mg/day)				# of Days per Year	Annual Exposures (mg/yr)			
	TYPICAL CASE		RANGE			TYPICAL CASE		RANGE	
	Dermal	Inhal.	Dermal	Inhalation		Dermal	Inhal	Dermal	Inhalation
Mixing/load/ Ammo/Water/ Aerial	240	neg	5.0-1200	neg	4	960	neg	20-4800	neg
Pilot/Ammo/ Water	0.37	neg	0.26-0.51	neg	4	1.5	0.1	1-2	neg-0.17
Ground/ Mixer/Loader Ammo/Water	16	neg	0.32-76	neg	26	420	neg	8.3	neg
Ground/ Application/ Ammo/Water	neg	neg	neg	neg	26	0.9	neg	0.2-1.8	neg-0.1
Total: Ammo/Ground	16	neg	0.32-76	neg	26	420.9	neg	8.5-2001.8	neg-0.1
Ground/ Mixer/Loader Cymbush/Water	16	neg	0.32-76	neg	26	420	neg	8.3	neg
Ground/ Application/ Cymbush/Water	neg	neg	neg	neg	26	0.9	neg	0.2-1.8	neg-0.1
Total:Cymbush/Ground	16	neg	0.32-76	neg	26	420.9	neg	8.5-2001.8	neg-0.1
Mixing/load/ Cymbush/Water/ Aerial	240	neg	5.0-1200	neg	4	960	neg	20-4800	neg
Pilot/ Cymbush/ Water	0.37	neg	0.26-0.51	neg	4	1.5	0.1	1-2	neg-0.17

References

Dubelman, S., R. Lauer, D.D. Arras, and S. A. Adams. 1982. J. Agric. Food Chem. Vol. 30. p. 528-532.

Jegier, Z. 1964. Arch. Environ. Health. 8: 565.