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

15 JUN 1989

OFFICE OF
PESTICIDES AND TOXIC SUBSTANCES

MEMORANDUM

SUBJECT: ASSESSMENT OF EXPOSURE OF INORGANIC ARSENIC
PESTICIDES TO HANDLERS AND OTHERS ASSOCIATED,
WITH THE USE OF THESE CHEMICALS ON COTTON, OKRA
AND GRAPES.

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Please find below the NDEB review of.....

HED Project #: 9-1362

Reg File/Rec #: 245174

Registration #: _____

Caswell #: 501B

Company Name: _____

Date Received: 4/26/89 Action Code: 870

Monitoring Study Requested: _____ Reviewing Time: 20 days

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1.0 INTRODUCTION

The Special Review Branch of SRRD has requested that NDEB make exposure assessments for certain non-wood uses of pesticides containing inorganic arsenic compounds as active ingredients because of the potential oncogenic risk to handlers, cotton gin workers and persons residing near cotton gins. The specific uses to be considered are: 1) arsenic acid as a cotton desiccant-exposure to mixer/loaders, applicators, ginning and stripping workers, trash haulers and area residents; 2) arsenic acid as an okra desiccant-mixer/loaders and applicators and 3) sodium arsenite on grapes-mixer/loaders and applicators. Previous exposure estimates can be found in EAB# 5271, J.C. Reinert 6/21/85.

NDEB does not have data on the application of arsenic acid or sodium arsenite to crops. Therefore, data from the NDEB surrogate data base will be used to estimate worker exposure. A discussion of this data base can be found below.

2.0 DISCUSSION OF NDEB DATA BASE

MIXER/LOADER EXPOSURE (SURROGATE DATA)

Study	No. Replicates	Exposure (mg/lb ai)	Clothing
Open pour			
4	18	0.93	long sleeve shirt, long pants, 50% protection; protective gloves, 90% protection.
Closed loading			
5	9	0.0041	long sleeve shirt, long pants, 50% protection; protective gloves, actual measurement.
6	9	0.025	long sleeve shirt, long pants, and protective gloves, actual measurement.

The average dermal exposures for mixer/loaders wearing normal work clothing (long sleeve shirt, long pants, and gloves) were 0.93 and 0.015 mg per lb ai for open pour and closed systems respectively.

A comparison of exposures to mixer/loaders wearing protective clothing when open pour and closed system loading is used can be made from the following data.

OPEN POUR - ASSUMING CHEMICAL RESISTENT PROTECTIVE CLOTHING

Study	Replicates	Exposure (mg/lb ai)
4	18	0.48
7	1	0.02

CLOSED LOADING - ASSUMING CHEMICAL RESISTENT PROTECTIVE CLOTHING

Study	Replicates	Exposure (mg/lb ai)
7	2	0.041
5	9	0.0014
6	9	0.0096

The data for open pour mixing/loading (19 replicates) indicate dermal exposure to be 0.46 mg/lb handled when a chemical resistant suit and protective gloves are worn. For closed loading the 20 replicates indicate a dermal exposure of 0.0091 mg/lb ai handled. These estimates assume that the protective clothing provides 100% protection to the torso and limbs.

GROUND-BOOM APPLICATOR EXPOSURE

To estimate the dermal exposure to ground-boom applicators, six studies available in the published literature were evaluated. The estimated dermal exposure for ground-boom applicators normalized to an application rate of 1.0 lb ai/A while wearing the clothing described is indicated below.

Study	Replicates	Exposure (mg/hr)	Clothing
4	18	40	Long-sleeved shirt, long pants.
8	21	0.7	Short-sleeved shirt, long pants.
5	12	0.93	Long-sleeved shirt, long pants.
9	23	72	Long-sleeved shirt, long pants.
10	20	0.4	Short-sleeved shirt, long pants.
11	7	9.4	Short-sleeved shirt, long pants.

The total of 101 replicates yields a weighted geometric mean exposure of 4.6 mg/hr. The large range of 0.4 to 72 mg/hr around this geometric mean reflects the wide range of exposure that can occur to applicators during ground-boom application. Tractor type and boom equipment can greatly affect exposure. Enclosed cabs provide a physical barrier between applicator and spray. Wojcek (9) found that shielding the boom yielded lower exposures. Wind can blow spray drift across the applicator and increase exposure. It is reasonable to assume that, depending on equipment used, weather conditions, and the personal habits of the applicator, the exposure received during any given application can fall anywhere within this range of 0.4 to 72 mg/hr.

Dubelman (5) and Wojcek (9) presented data on respiratory exposure. The 26 replicates, normalized to an application rate of 1.0 lb ai/A, ranged from non-detectable to 412 ug/hr with a weighted mean respiratory exposure of 84 ug/hr.

PILOT EXPOSURE

To estimate the exposure to pilots, NDEB reviewed six studies available in the published literature. To the extent possible, it was assumed that the pilots wore long-sleeves shirts and long pants. In the Maddy (12), Peoples (6), and Mumma (13) studies, the actual residue measured under the clothing was used to estimate dermal exposure. Attalah (14) presented his data as calculated dermal exposures that assumed long pants and short-sleeved shirts that completely eliminated exposure to the covered areas of the body. The pilot exposure from the Lavy (7) study was calculated assuming the pilots wore long-sleeved shirts and long pants that completely eliminated exposure to the covered body areas. The Lavy study had an insufficient number of patches to estimate exposure to the legs.

The estimated pilot dermal exposures adjusted to an application rate of 1.0 lb ai/A are presented below.

<u>Study</u>	<u>Replicates</u>	<u>Exposure (mg/hr)</u>
7	3	0.10
12	4	0.021
6	11	0.86
11	6	0.80
14	4	0.38

The dermal exposure ranged from 0.021 to 0.86 mg/hr with a weighted mean exposure of 0.58 mg/hr.

Five of the studies presented respiratory exposure data for pilots. The calculated respiratory exposures, adjusted to an application rate of 1.0 lb ai/A, were not detectable for Lavy (7), 24 ug/hr for Maddy (12), 45 and 9 ug/hr for Peoples (6), 6 ug/hr for Mumma (13) and 2 ug/hr for Atallah (14). Based on a weighted average for the 28 replicates, the estimated pilot respiratory exposure at an application rate of 1.0 lb/A is 18 ug/hr

3.0 ESTIMATION OF EXPOSURE TO PESTICIDES CONTAINING INORGANIC ARSENIC COMPOUNDS AS ACTIVE INGREDIENTS

3.1 COTTON

Arsenic acid is registered for use as a cotton desiccant with about 2.25 million pounds used annually for this purpose in Texas and Oklahoma. This amounts to about 90% of all arsenic acid usage. It is applied to cotton either aerially or by ground boom prior to harvest to cause leaf drop and facilitate the use of stripper machines for harvesting. Desiccation reduces the potential for damage to the cotton from excess moisture in the leaves at harvest.

ASSUMPTIONS FOR GROUND AND AIR APPLICATION

(1) Mixer/loaders and applicators wear normal work clothing (not protective clothing) and the mixer/loader wears gloves. Use of a respirator is required by the label. *Cotton*

(2) The spray operator and mixer/loader are the same person if grower applied; they may be different persons for commercial application.

(3) For skip-row cropping, the application rate is 2/3 of that for full cultivation. Reported exposures should be reduced by one third to reflect skip-row cropping.

(4) For ground-boom application by growers, 60 acres are treated per day at 2.33 lbs As per acre for 8 days per year. Application time is 5.26 hours. Time for mixing and loading is 0.24 hours per day (1)(20).

(5) For commercial ground-boom application, 270 acres are treated per day at 2.33 lbs As per acre for 28 days per year. Application time is 6.79 hours/day. Time for mixing and loading is 1.03 hours/day (20).

(6) For aerial application, 675 acres are treated per day at 2.33 lbs As per acre for 6 days per year. Application time is 2.59 hours. Time for mixing and loading is 2.86 hours per day (2)(20).

*(20) Protected data
Keep*

A. GROUND-BOOM APPLICATION

Grower - Daily dermal exposure to mixer/loader (open pour) = 60 acres treated per day x 2.33 lbs As per acre x 0.93 mg/lb (unit exposure for open system loading without protective clothing) = 130 mg/day.

Commercial - Daily dermal exposure to mixer/loader (open pour) = 270 acres treated per day x 2.33 lbs As per acre x 0.93 mg/lb (unit exposure for open system loading without protective clothing) = 585 mg/day.

Grower - Daily dermal exposure to mixer/loader (closed system) = 60 acres treated per day x 2.33 lbs As per acre x 0.015 mg/lb (unit exposure for closed system loading without protective clothing) = 2.1 mg/day.

Commercial - Daily dermal exposure to mixer/loader (closed system) = 270 acres treated per day x 2.33 lbs As per acre x 0.015 mg/lb (unit exposure for closed system loading without protective clothing) = 9.4 mg/day.

Grower - Daily dermal exposure to applicators = 5.26 hours application time x 4.6 mg per hour (unit exposure based on application rate of one pound ai per acre) x 2.33 pounds ai per acre (adjustment factor for application rate) = 56 mg/day.

Commercial - Daily dermal exposure to applicators = 6.79 hours application time x 4.6 mg per hour (unit exposure based on application rate of one pound ai per acre) x 2.33 pounds ai per acre (adjustment factor for application rate) = 73 mg/day.

Grower - Daily inhalation exposure to mixer/loaders = 0.24 hours required for mixing and loading x 0.045 mg per hour (unit exposure - composite of open and closed systems - without protective clothing (15)) x 2.33 pounds ai per acre (adjustment factor for application rate) = 0.025 mg/day.

Commercial - Daily inhalation exposure to mixer/loaders = 1.03 hours required for mixing and loading x 0.045 mg per hour (unit exposure - composite of open and closed systems - without protective clothing (15)) x 2.33 pounds ai per acre (adjustment factor for application rate) = 0.108 mg/day.

(15) Lunch break
Paragraph error

Grower - Daily inhalation exposure to applicators = 5.26 hours
 required for application x 0.084 mg per hour (unit exposure bases
 on application rate of one pound ai per acre) x 2.33 pounds ai per
 acre (adjustment for application rate)
 = 1.0 mg/day

Commercial - Daily inhalation exposure to applicators = 6.79 hours
 required for application x 0.084 mg per hour (unit exposure bases
 on application rate of one pound ai per acre) x 2.33 pounds ai per
 acre (adjustment for application rate)
 = 1.3 mg/day

Grower - Yearly exposure rate = Daily exposure rate x 8 (number of
 days worked per year)

Commercial - Yearly exposure rate = Daily exposure rate x 28
 (number of days worked per year)

Grower - Yearly dermal exposure to mixer/loader (open pour) = 8 x
 130 mg/day
 = 1040 mg/yr.

Commercial - Yearly dermal exposure to mixer/loader (open pour) =
 28 x 585 mg/day
 = 16400 mg/yr.

Grower - Yearly dermal exposure to mixer/loader (closed system) =
 8 x 2.1 mg/day
 = 17 mg/yr.

Commercial - Yearly dermal exposure to mixer/loader (closed
 system) = 28 x 9.4 mg/day
 = 264 mg/yr.

Grower - Yearly dermal exposure to applicator = 8 x 56 mg/day
 = 448 mg/yr.

Commercial - Yearly dermal exposure to applicator = 28 x 73 mg/day
 = 2040 mg/yr.

Grower - Yearly inhalation exposure to mixer/loader = 8 x 0.025
 mg/day
 = 0.20 mg/yr.

Commercial - Yearly inhalation exposure to mixer/loader = 28 x
 0.108 mg/day
 = 3.0 mg/yr.

Grower - Yearly inhalation exposure to applicators = 8×1.0
 mg/day
 = 8.0 mg/yr.

Commercial - Yearly inhalation exposure to applicators = 28×1.3
 mg/day
 = 36 mg/yr.

Grower - Total yearly exposure (dermal + inhalation) to
 mixer/loader (open pour)
 = 1040 mg/yr.

Commercial - Total yearly exposure to (dermal + inhalation) to
 mixer/loader (open pour)
 = 16400 mg/yr.

Grower - Total yearly exposure (dermal + inhalation) to
 mixer/loader (closed system)
 = 17 mg/yr.

Commercial - Total yearly exposure (dermal + inhalation) to
 mixer/loader (closed system)
 = 267 mg/yr.

Grower - Total yearly exposure (dermal + inhalation) to applicator
 = 456 mg/yr.

Commercial - Total yearly exposure (dermal + inhalation) to
 applicator
 = 2080 mg/yr.

Grower - If the same person performs both mixer/loader and
 applicator tasks, total (dermal + inhalation) exposure per year
 would be:

Mixer/loader (open pour) + applicator = 1500 mg/yr.

Mixer/loader (closed system) + applicator = 470 mg/yr.

B. AERIAL APPLICATION

Daily dermal exposure to mixer/loader (open pour) = 675 acres
 treated per day \times 2.33 lbs As per acre \times 0.93 mg/lb (unit
 exposure for open system loading without protective clothing)
 = 1463 mg/day.

Daily dermal exposure to mixer/loader (closed system) = 675 acres
 treated per day \times 2.33 lbs As per acre \times 0.015 mg/lb (unit
 exposure for closed system loading without protective clothing)
 = 24 mg/day.

Daily dermal exposure to applicators = 2.59 hours application time x 0.58 mg per hour (unit exposure based on application rate of one pound ai per acre) x 2.33 pounds ai per acre (adjustment factor for application rate) = 3.5 mg/day.

Daily inhalation exposure to mixer/loaders = 2.86 hours required for mixing and loading x 0.045 mg per hour (unit exposure - composite of open and closed systems without protective clothing) x 2.33 pounds ai per acre (adjustment factor for application rate) = 0.30 mg/day.

Daily inhalation exposure to applicators = 2.59 hours required for application x 0.018 mg per hour (unit exposure bases on application rate of one pound ai per acre) x 2.33 pounds ai per acre (adjustment for application rate) = 0.11 mg/day

Yearly exposure rate = Daily exposure rate x 6 (number of days worked per year)

Yearly dermal exposure to mixer/loader (open pour) = 6 x 1463 mg/day = 8800 mg/yr.

Yearly dermal exposure to mixer/loader (closed system) = 6 x 24 mg/day = 144 mg/yr.

Yearly dermal exposure to applicator = 6 x 3.5 mg/day = 21 mg/yr.

Yearly inhalation exposure to mixer/loader = 6 x 0.30 mg/day = 2.0 mg/yr.

Yearly inhalation exposure to applicators = 6 x 0.11 mg/day = 0.7 mg/yr.

Total yearly exposure (dermal + inhalation) to mixer/loader (open pour) = 8800 mg/yr.

Total yearly exposure (dermal + inhalation) to mixer/loader (closed system) = 146 mg/yr.

Total yearly exposure (dermal + inhalation) to applicator = 22 mg/yr.

C. STRIPPER - Post Application Exposure

These workers drive the stripper machines used to harvest the cotton after it had been desiccated by treatment with arsenic acid. Air concentration data for two scenarios are reported (16): one for a closed cab (commercial) stripper and one for a harvester drawn by an open tractor (private or small scale operator). The closed cab workers work for about 9.5 hours per day for 100 days per year. The inorganic arsenic level measured inside the cabs was reported as less than 0.0001 ug/liter, the level outside the cab reaches 0.003 ug/liter. Assuming that a worker spends some time outside the cab during the day an exposure level of 0.0001 ug/liter is assumed. The open tractor harvesters are exposed to a reported mean arsenic concentration of 0.0011 ug/liter for about 10 hours per day for 15 days each year.

Inhalation exposure for the closed cab worker (ug/day) = $0.0001 \text{ ug/liter} \times 29 \text{ liter/minute breathing rate for light work} \times 9.5 \text{ hours worked per day} \times 60 \text{ minutes/hour} = 1.65 \text{ ug/day}$

Exposure for one year would be $1.65 \text{ ug/day} \times 100 \text{ days worked per year} = 165 \text{ ug/year} = 0.2 \text{ mg/year}$.

Inhalation exposure for the open tractor operator (ug/day) = $0.0011 \text{ ug/liter} \times 29 \text{ liters/minute breathing rate for light work} \times 10 \text{ hours worked per day} \times 60 \text{ minutes/hour} = 19 \text{ ug/day}$.

Exposure for one year would be $19 \text{ ug/day} \times 15 \text{ days worked per year} = 285 \text{ ug/year} = 0.3 \text{ mg/year}$.

Dermal exposure to strippers cannot be estimated due to a lack of data. In an earlier review on the non-wood uses of arsenic-containing pesticides (EAB # 5271, Reinert, 6/21/85), an estimated dermal exposure to both strippers and cotton trash disposal workers of 1.46 mg/day was indicated. This value was based on data in an EAB Memorandum (1984) by Noren, S., Exposure Assessment For Aliette. This memorandum cannot be found in the OPP for Aliette, and therefore the estimated dermal exposure value cannot be verified. It is further noted that in a memo from P. Shuda to A. Rispin (12/1/87) concerning exposure assessments for inorganic arsenic, the dermal exposure to strippers is reported as negligible.

D. GINNERS

Ginners work inside of the cotton gin tending and maintaining the ginning machinery. They can work twelve hours per day seven days per week for up to 100 days per year, and are exposed to a reported mean air concentration of 0.0039 ug/liter of inorganic arsenic (16).

Inhalation exposure to a ginner (ug/day) = 0.0039 ug/liter x 29 liters/minute breathing rate for light work x 12 hours worked per day x 60 minutes/hour = 81 ug/day.

Inhalation exposure for one year would be 81 ug/day x 100 days worked per year = 8100 ug/yr = 8.1 mg/year.

Dermal exposure to ginners cannot be estimated due to a lack of data. In earlier reviews (Reinert EFB# 5271, 6/21/85 and Day EFB# 6082, 11/27/85) ginner dermal exposure is not addressed while inhalation estimates were made. In an EAB Memorandum by P. Shuda, 12/1/87, dermal exposure of ginners is indicated as negligible.

E. COTTON TRASH DISPOSAL

The trash hauler loads his truck with cotton trash, which accumulates during ginning, from a bin outside of the gin. He then drives the truck to a field, and while driving across the field the trash is removed automatically by a spreading device. A typical trash hauler is assumed to work 12 hours per day for 100 days per year. Inhalation exposure to inorganic arsenic at a reported mean level of 0.0028 ug/liter (16) is also assumed.

Inhalation exposure to a trash hauler (ug/day) = 0.0028 ug/liter x 29 liters/minute breathing rate for light work x 12 hours worked per day x 60 minutes/hour = 58 ug/day.

Inhalation exposure for one year would be 58 ug/day x 100 days worked per year = 5800 ug/yr = 5.8 mg/year.

Dermal exposure to trash haulers cannot be estimated due to a lack of data. In a previous review (Reinert, EFB# 5271, 6/21/85) dermal exposure to trash haulers was estimated at 1.46 mg/day. This value was reportedly based on data in an EAB Memorandum by Noren, S., Exposure Assessment for Aliette. This memorandum cannot be found in the Branch file for Aliette, and therefore the estimated dermal exposure value cannot be verified. It is further noted that in a memo from P. Shuda to A. Rispin (12/1/87) concerning exposure assessments for inorganic arsenic, the dermal exposure to trash haulers was reported as 1.45 mg/day and 0.145 mg/year.

E. AREA RESIDENTS

Persons living near cotton gins are subject to inhalation exposure from gin emissions, usually suspended particulate matter which may contain adsorbed arsenic. The amount of emissions mainly depends on the size of the gin, the duration of operation and the degree of emission control. For purposes of this exposure assessment the weighted mean concentration of arsenic for one calendar at 100 meters from a typical gin is taken as 0.12 ug/m^3 (17). The breathing rate for area residents is assumed to be $1.0 \text{ m}^3/\text{hour}$.

DAQPS

Daily inhalation exposure to area residents (100 meters from the gin) = $0.12 \text{ ug/m}^3 \times 1.0 \text{ m}^3/\text{hour} \times 24 \text{ hours/day} = 2.9 \text{ ug/day}$.

Yearly inhalation exposure to area residents (100 meters from the gin) = $2.9 \text{ ug/day} \times 365 \text{ days/year} = 1.1 \text{ mg/year}$.

3.2 OKRA

Arsenic acid is registered for use as a desiccant on okra grown for seed in Arizona under a 24(c) registration. The maximum state acreage for this use is 500 acres, typically about 400 acres are treated, with an average plot size of 40 acres. All application is done aurally at 2.33 lb As per acre with 100 acres treated per day for four days each year. Usually only one application is made per year but sometimes a second application made a week after the first one may be needed. Closed system loading is used, and only one pilot and one loader can treat all of the acreage. Product label does not require use of protective clothing or gloves, however, use of a respirator is recommended.

ASSUMPTIONS

- (1) Mixer/loaders and applicators wear normal work clothing (not protective clothing) and the mixer/loader wears gloves.
- (2) Application is made aurally to 100 acres per day for four days per year.
- (3) A closed system is used for mixing and loading.
- (4) Application time is taken as 0.38 hours and mixing/loading time is taken as 0.42 hours. (Pro rated from use data on cotton (2)).
- (5) Use of a respirator can reduce reported inhalation exposure by 90%.

Daily dermal exposure to mixer/loader = 100 acres treated per day
x 2.33 lbs As per acre x 0.015 mg/lb (unit exposure - closed
system loading without protective clothing)
= 3.5 mg/day.

Daily dermal exposure to applicators = 0.38 hours application time
x 0.58 mg per hour (unit exposure based on application rate of one
pound ai per acre) x 2.33 pounds ai per acre (adjustment factor
for application rate) = 0.52 mg/day.

Daily inhalation exposure to mixer/loaders = 0.42 hours required
for mixing and loading x 0.045 mg per hour (unit exposure -
composite of data for closed and open loading systems (3)) x 2.33
pounds ai per acre (adjustment factor for application rate) =
0.044 mg/day.

Daily inhalation exposure to applicators = 0.38 hours required for
application x 0.018 mg per hour (unit exposure bases on
application rate of one pound ai per acre) x 2.33 pounds ai per
acre (adjustment for application rate)
= 0.016 mg/day

Yearly exposure rate = Daily exposure rate x 4 (number of days
worked per year)

Yearly dermal exposure to mixer/loader (closed system) = 4 x 3.5
mg/day = 14 mg/yr.

Yearly dermal exposure to applicator = 4 x 0.52 mg/day
= 2.1 mg/yr.

Yearly inhalation exposure to mixer/loader = 4 x 0.044 mg/day
= 0.18 mg/yr.

Yearly inhalation exposure to applicators = 4 x 0.016 mg/day =
0.064 mg/yr.

Total yearly exposure (dermal + inhalation) to mixer/loader
= 14 mg/yr.

Total yearly exposure (dermal + inhalation) to applicator
= 2.1 mg/year

3.3 GRAPES

Sodium arsenite is used as a fungicide to control "black measels" on grapes. It is applied by vertical hydraulic boom during the dormant period and use is primarily restricted to California. Use of sodium arsenite in California requires application from closed cabs, closed mixing and loading systems and use of protective clothing and respirator (18). The product label, Laaco Sodium Arsenite Solution No. 6, (EPA Reg. No. 962-349 AA) does not contain recommendations for protective clothing. There are no surrogate data in the NDEB data base for vertical hydraulic boom application.

An approximate estimate of exposure to applicators can be made based on data for air blast application of lead arsenate to grapefruit in Florida (19). In this study, average total applicator exposures were reported as 54 and 57 mg arsenic/hr (at an application rate of 4.7 kg ai/ha - 0.1% spray solution) and 95 mg arsenic/hr (at an application rate of 6.2 kg ai/ha - 0.3% spray solution). For applicators mean exposures were reported as 41% to hands, 57% to the rest of the body except head and neck and 1% to the head and neck. Inhalation exposure was negligible, less than 0.01%. Exposure to mixer/loaders can be estimated by using the NDEB surrogate data base described in Section 2 of this review.

ESTIMATION OF EXPOSURE TO MIXER/LOADERS USING NDEB SURROGATE DATA BASE.

ASSUMPTIONS

- (1) Grapes are treated at 6.8 lb arsenic/acre with 19 acres sprayed per day (3).
- (2) Closed system mixing and loading is employed with workers wearing gloves and protective clothing. Unit exposure is taken to be 0.0091 mg/lb ai handled.
- (3) Private growers work 2 days per year and commercial applicators work 10 days per year.
- (4) Inhalation exposure is expected to be negligible with closed system loading and use of respirators.

Daily dermal exposure to mixer/loader = 19 acres treated per day x 6.8 lbs As/acre x 0.0091 mg/lb (unit exposure for closed loading system and protective clothing) = 1.18 mg/day.

Yearly dermal exposure to mixer/loader (private grower) = 1.18 mg/day x 2 days worked per year = 2.4 mg/year.

Yearly dermal exposure to mixer/loader (commercial applicator) =
 $1.18 \text{ mg/day} \times 10 \text{ days worked per year} = 12 \text{ mg/year.}$

ESTIMATION OF EXPOSURE TO APPLICATORS TREATING GRAPES WITH SODIUM ARSENITE BASED ON SURROGATE DATA FOR THE TREATMENT OF GRAPEFRUIT WITH LEAD ARSENATE BY AIR BLAST SPRAY

ASSUMPTIONS

- (1) Surrogate data on the air blast treatment of grapefruit with lead arsenate will provide an approximation of applicator exposure for vertical spray application of sodium arsenite to grapes.
- (2) Grapes are treated at 6.8 lb arsenic/acre with 19 acres sprayed per day (3).
- (3) Daily application time is 278.2 minutes (4.64 hours) (3).

Exposure Estimation

(1) Application rate - 4.7 kg/acre, 0.1% spray solution.
 Data for two applicators were reported: $(54 + 57 \text{ mg arsenic/hour})/2 = 55.5 \text{ mg arsenic/hr}$ (average total exposure).
 If it is assumed that the applicator wears gloves and protective clothing as are required in California then: $55.5 \text{ mg arsenic/hr} \times 0.99$ (fraction of exposure to areas covered by clothing and gloves) $\times .10$ (protective value) $+ .01 \times 55.5$ (exposure to head and neck) = $6.05 \text{ mg arsenic/hr}$ (surrogate data adjusted for protective clothing and gloves)

$4.7 \text{ kg/ha lead arsenate} \times 2.2 \text{ lbs/kg} \times 0.404 \text{ ha/acre} \times 0.203 \text{ lbs arsenic/lb lead arsenate} = 0.85 \text{ lbs arsenic/acre}$ application rate to grapefruit.

$6.05 \text{ mg arsenic/hour} \times (6.8 \text{ lbs arsenic/acre application rate to grapes} / 0.85 \text{ lbs arsenic/acre application rate to grapefruit}) = 48.4 \text{ mg arsenic/hr}$ - exposure to applicator - open cab - protective clothing and gloves (90% protection).

Daily exposure to applicator = $48.4 \text{ mg arsenic/hr} \times 4.64 \text{ hours worked per day} = 225 \text{ mg arsenic per day}$

Yearly exposure (grower) = $225 \text{ mg arsenic/day} \times 2 \text{ days worked per year} = 450 \text{ mg arsenic/year.}$

Yearly exposure (commercial applicator) = $225 \text{ mg arsenic/day} \times 10 \text{ days worked per year} = 2300 \text{ mg arsenic/year.}$

(2) Application - 6.2 kg/acre, 0.3% spray solution.
 95 mg arsenic/hr total exposure (surrogate data) x .99 (fraction of exposure to areas covered by clothing and gloves) x .10 (protective value) + .01 X 95 (exposure to head and neck) = 10.4 mg arsenic/hr (surrogate data adjusted for protective clothing and gloves)

6.2 kg/ha lead arsenate x 2.2 lbs/kg x 0.404 ha/acre x 0.203 lbs arsenic/lb lead arsenate = 1.12 lbs arsenic/acre application rate to grapefruit.

10.4 mg arsenic/hour x (6.8 lbs arsenic/acre application rate to grapes/1.12 lbs arsenic/acre application rate to grapefruit) = 63 mg arsenic/hr - exposure to applicator - open cab - protective clothing and gloves (90% protection).

Daily exposure to applicator = 63 mg arsenic/hr x 4.64 hours worker per day = 292 mg arsenic per day

Yearly exposure (grower) = 292 mg arsenic/day x 2 days worked per year = 580 mg arsenic/year (open cab).

Yearly exposure (commercial applicator) = 292 mg arsenic/day x 10 days worked per year = 2900 mg arsenic/year (open cab).

The exposure estimates developed above are for application using open cab equipment. In California, closed cabs are required for application of sodium arsenite in grape vineyards. NDEB does not have data to estimate the reduction in exposure due to the use of closed cabs for the application of sodium arsenite by vertical spray hydraulic boom equipment to grapes.

TABLE 1. INHALATION EXPOSURE RESULTING FROM NON-WOOD USES OF PESTICIDES CONTAINING INORGANIC ARSENIC

Use	Days exposed per year	Annual Exposure (mg/yr)	Coastal Bend: Blacklands	High & Rolling Plains
1. Arsenic acid as a cotton dessicant				
- mixer/loader (ground)				
private	8	0.2	0.17	0.35
commercial	28	3.0	5.0	2.8
- ground-boom applicator				
private	8	8.0	7.0	14.2
commercial	28	36.0	60.0	33.3
- mixer/loader (aerial) (closed loading)	6	2.0	2.6	11.8
- aerial applicator	6	0.7	0.9	3.8
- stripping				
closed cab	100	0.2		
open tractor	15	0.3		
- ginning	100	8.1		
- cotton trash disposal	100	5.8		
- area residents (100 meters from gin)	365	1.1		
2. Arsenic acid as a desiccant on okra				
- mixer/loader	4	0.2		
- pilot	4	0.06		
3. Sodium arsenite on grapes				
- Mixer/loader		* neg.		
- Applicator		**		

* Mixer/loader inhalation exposure is expected to be negligible with use of closed loading systems and proper use of respirators as required in California.

** NDEB does not have data to adequately estimate inhalation exposure for vertical spray application of sodium arsenite to grapes. Use of closed cabs and respirators is required in California. For an accurate assessment, inhalation data should be requested from the registrant.

TABLE 2. DERMAL EXPOSURE RESULTING FROM USES OF PESTICIDES CONTAINING ARSENIC

<u>Use</u>	<u>Days exposed per year</u>	<u>Annual Exposure (mg/yr)</u>	<i>Central Basin The Netherlands</i>	<i>High & Heavy France</i>
1. Arsenic acid as a cotton dessicant				
- mixer/loader (ground)				
private (open pour)	8	1040	920	1540
private (closed system)	8	17	15	30
commercial (open pour)	28	16400	27000	15000
commercial (closed system)	28	264	440	244
- ground-boom applicator				
private (open cab)	8	448		
commercial (open cab)	28	2040	Same	
- M/L + App (private)				
(open pour)	8	1500	1328	2656
(closed system)	8	470	416.1	932.3
- mixer/loader (aerial)				
(open pour)	6	8800	8500	37,000
(closed system)	6	144	146	610
- aerial applicator	6	21	21	92
- stripping		unknown		
- ginning		unknown		
- area residents		unknown		
- cotton trash disposal		unknown		
2. Arsenic acid as a desiccant on okra				
- mixer/loader (closed system)	4	14		
- pilot	4	2.1		
3. Sodium arsenite on grapes				
- mixer/loader grower (closed system)	2	2.4		
commercial (closed system)	10	12		
- applicator grower (open cab)	2	* 450 - 580		
commercial (open cab)	10	** 2300 - 2900		

* Exposure estimates are based on surrogate studies on air blast application of lead arsenate to grapefruit. Application of sodium

arsenite to grapes is by vertical hydraulic spray. Indicated exposure values are for two studies carried out at different application rates and spray concentrations.

** Exposure data are for application from open cabs. Use of closed cabs is required in California. NDEB does not have data to adequately estimate exposure to applicators operating vertical spray equipment from closed cabs. In one study, use of enclosed cabs for ground boom application has been shown to reduce exposure by 85% from that experienced for open tractor application (9). For more accurate estimates of exposure to workers applying sodium arsenite to grapes, the registrant should be requested to conduct field exposure studies which include the use of vertical spray equipment and closed cabs.

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(20) Projected Parameters and Data for Application Exposure for
Applying Arsenic Acid to Cotton - Ground Application by Commercial
Applicator (Keitt, BAB/BEAD (6/05/89)

cc: Correspondence file
Arsenic file
Circulation
SACB
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