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Item ID Number 01598

Author

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Report/Article Title Notes: Ranch Hand Exposure

Journal/Book Title

Year 0000

Month/Day

Color

Number of Images 9

Description Notes Includes both handwritten notes by Alvin Young and typed notes.

RANCH HAND EXPOSURE

CONSOLE Operator

VAPORS Worst Case from PACER NO. NCBC

2,4-D = 135 $\mu\text{g}/\text{m}^3$	} Air Concentrations <u>90° F</u>
2,4,5-T = 80 $\mu\text{g}/\text{m}^3$	

Assuming unprotected worker respiring at 30 X/min @ 500 ml / resp = 7.2 m^3/day

∴ if During 8 hours:

For 2,4-D / ^{EXPOSURE} VIA Respiration: $135 \frac{\mu\text{g}}{\text{m}^3} \times 7.2 \frac{\text{m}^3}{\text{day}} = 972 \mu\text{g}/\text{day}$

For 2,4,5-T / via Respiration: $80 \frac{\mu\text{g}}{\text{m}^3} \times 7.2 \frac{\text{m}^3}{\text{day}} = 576 \mu\text{g}/\text{day}$

TOTAL ORANGE = 1,548 $\mu\text{g}/\text{day}$

IE 70 kg man

$\frac{1,548 \mu\text{g}}{\text{day}} \times \frac{1}{70 \text{ kg man}} = 22 \mu\text{g}/\text{kg}$ Daily

SKIN EXPOSURE: Worst Case from Levy

4# 2,4,5-T formulation - Ester

^{2,4,5-T}
~~2.54~~ mg/kg : Daily

IF 4# 2,4-D = 5.08 mg/kg

Patch Studies

FROM MILK IF 210 MISSIONS: E each mission / 1/2 day - 105 days

VIA Respiration = 2.30 mg/kg

Via skin = 533.40 mg/kg

Total = 535 mg/kg For Tour

Total

RANCH HAND EXPOSURE

PILOT / COPILOT / NAVIGATOR

- VAPOR Received $\frac{1}{2}$ of Control Operator
= 1.50 mg/kg
- SKIN Received $\frac{1}{5}$ of Control Operator
= 105 mg/kg

TOTAL = 106.5 mg/kg ^{ORANGE}

MARINE

Dermal = 132 μ g/kg

Resp. = 15 mg/kg

147 μ g/kg

\approx 0.15 mg/kg

Direct Spray

2.1 mls Orange

$$2.1 \text{ gal } 10 \times \frac{9 \text{ gal}}{3785 \text{ ml}} \times \frac{8.6 \text{ lbs}}{9 \text{ gal}} \times \frac{1,000 \text{ gms}}{2.2 \text{ lbs}} = 2.17 \text{ gms}$$

$$2.17 \text{ gms Orange} \times \frac{1}{70 \text{ kg man}} = 0.03 \text{ gms/kg man}$$

30 mg/kg

$\times 0.6 \text{ percent} = 1.8 \text{ mg/kg}$

MISSION DATA

<u>Crew Member</u>	<u>Time in Vietnam</u>	<u># Missions</u>	<u># Hours</u>	<u>Duration of Mission</u>
Pilot	62-63	6 months	80	1.93
Navigator	66-67	1 yr	209	2.12
Pilot	66-67	1 yr	341	1.64
Pilot	66-67	1 yr	145	1.38
Pilot	67-68	1 yr	154	1.40
Pilot	67-68	1 yr	148	1.59
Pilot	68-69	1 yr	310	2.03
Pilot	68-69	1 yr	105	1.58
Pilot	69-70	1 yr	211	1.25
Pilot	69-70	5 months	95	1.51
			<u>1,798</u>	
			<u>3,013</u>	
Ave.		150	251	1.67 Hr.

DIRECT APPLICATION TO MAN



1 SQUARE FOOT PLANAR SURFACE

110 LB HUMAN

= 50 KG BODY WEIGHT

MAN STANDING IN OPEN AND SPRAYED DIRECTLY
IS ESTIMATED TO INTERCEPT SPRAY EQUIVALENT TO
1 SQUARE FOOT OF HORIZONTAL PLANAR SURFACE

2,4-D + 2,4,5-T

12.63 + 13.23 LB/A = 131.3 + 137.6 MG/SQ. FT.

= 131.3 + 137.6 MG/50 KG BODY WEIGHT

= 2.6 + 2.7 MG/KG OF BODY WEIGHT

= 1/100 LD₅₀ FOR 2,4-D + 2,4,5-T IN RATS

TCDD

6 MG/A = 0.14 µG/SQ. FT.

= 0.14 µG/50 KG BODY WEIGHT

= 0.003 µG/KG OF BODY WEIGHT

= 1/10,000 LD₅₀ IN RATS

AS SINGLE TOPICAL APPLICATION ON HEAD AND SHOULDERS,
PROTECTED BY HAIR AND CLOTHING,
CAN BE WASHED OFF.

DIRECT CONTAMINATION OF SOIL



BARE SOIL

1 ACRE OF SOIL
3 INCHES THICK
= 1 MILLION POUNDS
OF SOIL

AGENT ORANGE SPRAYED ON BARE SOIL
AND PENETRATING TO A DEPTH OF 3 INCHES
WOULD GIVE MAXIMUM CONCENTRATION IN SOIL:

2,4-D = 12.63 LB/1 MILLION LB = 12.63 PPM
2,4,5-T = 13.23 LB/1 MILLION LB = 13.23 PPM

IF 2,4,5-T CONTAINED 1 PPM TCDD,
SOIL WOULD CONTAIN 0.000013 PPM TCDD
= 0.013 PARTS PER BILLION TCDD
= 13 PARTS PER TRILLION TCDD

LEVELS IN SOIL WOULD GENERALLY BE
CONSIDERABLY LOWER THAN THIS DUE TO
INTERCEPTION OF SPRAY BY OVERSTORY FOLIAGE,
UNDERSTORY FOLIAGE, BRUSH, GRASS AND
GROUND LITTER

DIRECT CONTAMINATION OF POND WATER



AVERAGE DEPTH 1 FT

1 SQ FT OF SURFACE 1 FT DEEP = 1 CU FT
= 62.4 LB = 28.4 KG OF WATER

AGENT ORANGE SPRAYED AT 3 GAL/A

DIRECTLY ON POND SURFACE

= 131.3 MG 2,4-D/28.4 KG = 5 PPM 2,4-D
+ 137.6 MG 2,4,5-T/28.4 KG = 5 PPM 2,4,5-T
+ 0.14 μ G TCDD/28.4 KG = 0.005 PPB TCDD

IF 50 KG WOMAN DRANK 2 LITERS OF THIS POND WATER
EACH DAY, SHE WOULD INGEST

0.2 MG 2,4-D + 0.2 MG 2,4,5-T + 0.002 μ G TCDD

PER KG OF BODY WEIGHT PER DAY, PROVIDED

IT ALL REMAINED IN SOLUTION OR SUSPENSION

AND DID NOT DEGRADE WITH TIME.

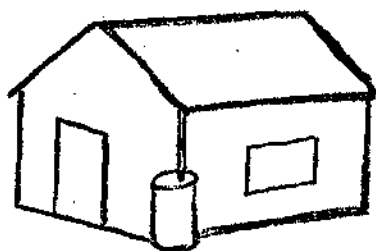
NO-EFFECT LEVELS IN TERATOGENIC STUDIES IN RATS:

FOR 2,4-D = 25 MG/KG BODY WEIGHT PER DAY

FOR 2,4,5-T = 24 MG/KG BODY WEIGHT PER DAY

FOR TCDD = 0.03 μ G/KG BODY WEIGHT PER DAY

DIRECT CONTAMINATION OF DRINKING WATER



HOUSE 20 x 50 FT.

ESTIMATED TO INTERCEPT

1000 SQ. FT. OF SPRAY

DIRECT SPRAYING OF 1000 SQ. FT. WILL DEPOSIT
131.3 GRAMS 2,4-D + 137.6 GRAMS 2,4,5-T + 0.14 MG TCDD

IF ROOF IS WASHED OFF COMPLETELY BY 0.5 INCH OF RAIN
AND ALL RUNOFF IS COLLECTED IN AN EMPTY CISTERN

$(0.5/12) \times 1000 \times 7.5 = 313$ GALLONS OF WATER
= 2600 LB OR 1180 KG OF WATER IN CISTERN

THE WATER COULD THEORETICALLY CONTAIN A MAXIMUM OF
111 PPM 2,4-D + 116 PPM 2,4,5-T + 0.0001 PPM TCDD

BUT AGENT ORANGE IS NOT THIS SOLUBLE IN WATER.

A SATURATED SOLUTION CONTAINS ONLY 20 PPM

= 10 PPM 2,4-D BUTYL ESTER + 10 PPM 2,4,5-T BUTYL ESTER

OR 8 PPM 2,4-D A.E. + 8 PPM 2,4,5-T A.E.

TCDD IS EXTREMELY INSOLUBLE IN WATER.

SATURATED SOLUTION CONTAINS 0.2 PPB TCDD.

IF A 50 KG WOMAN DRANK 2 LITERS OF SATURATED WATER EACH DAY,
SHE COULD INGEST 16 MG 2,4-D + 16 MG 2,4,5-T + 0.4 μ G TCDD
EQUIVALENT TO 0.3 MG/KG/DAY 2,4-D + 0.3 MG/KG/DAY 2,4,5-T
+ 0.008 μ G/KG/DAY TCDD IF NONE DECOMPOSED WITH TIME.

HOWEVER, SATURATED SOLUTION OF AGENT ORANGE WOULD NOT
LIKELY BE USED AS DRINKING WATER DUE TO UNPLEASANT
ODOR AND DISAGREEABLE TASTE.

DIRECT CONTAMINATION OF CROP

2,4-D AND 2,4,5-T ARE USED AS HERBICIDES TO CONTROL BROAD-LEAF WEEDS IN TOLERANT CROPS SUCH AS RICE AND SUGARCANE. RECOMMENDED RATES FOR RICE ARE 1.25 TO 1.7 LB/A. DIRECT SPRAYING WITH AGENT ORANGE AT 3 GAL/A (25.86 LB PHENOXY ACID EQUIVALENT PER ACRE) WOULD CAUSE DAMAGE AND LITTLE OR NO CROP WOULD SURVIVE TO MATURITY.

IF PART OF THE SPRAY IS INTERCEPTED BY OVERSTORY AND UNDERSTORY FOLIAGE, CROPS COULD RECEIVE TOLERATED DOSES OF 2,4-D OR 2,4,5-T.

IF THE RICE RECEIVED 1.25 LB 2,4-D + 2,4,5-T PER ACRE NO DETECTABLE RESIDUE (<0.01 PPM) 2,4-D OR 2,4,5-T WOULD BE PRESENT IN THE 2000 KG OF RICE GRAIN HARVESTED FROM THAT ACRE.

IF THE 2,4,5-T CONTAINED 1 PPM TCDD AND ALL THE TCDD ENDED UP IN THE RICE GRAIN, THE GRAIN WOULD CONTAIN ABOUT 0.00015 PPM TCDD = 0.15 PPB TCDD.

IF A 50 KG WOMAN ATE 300 GRAMS OF THIS RICE EACH DAY, SHE WOULD INGEST LESS THAN 0.001 µG OF TCDD PER KG OF BODY WEIGHT PER DAY.

UNLIKELY AS THE ABOVE MAY BE, IT IS STILL 30 TIMES LESS THAN THE NO-EFFECT LEVEL FOUND IN TERATOGENIC STUDIES IN RATS.

M. Long 10/6/72

AGENT ORANGE

50% N-BUTYL ESTER OF 2,4-D

50% N-BUTYL ESTER OF 2,4,5-T

4.21 LB 2,4-D ACID EQUIVALENT (A.E.) PER GALLON

4.41 LB 2,4,5-T ACID EQUIVALENT PER GALLON

APPLIED IN VIETNAM AT 3 GAL. PER ACRE

= 12.63 LB 2,4-D A.E./A

+ 13.23 LB 2,4,5-T A.E./A

TOTAL = 25.86 LB PHENOXY A.E./A

1 LB/A = 10.4 MILLIGRAMS PER SQUARE FOOT

AGENT ORANGE AT 3 GALLONS PER ACRE

= 131.3 MG 2,4-D A.E./SQ FT

+ 137.6 MG 2,4,5-T A.E./SQ FT

IF THE 2,4,5-T BUTYL ESTER CONTAINS 1 PPM

2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN (TCDD)

USE OF AGENT ORANGE AT 3 GALLONS PER ACRE

= 6 MILLIGRAMS TCDD PER ACRE (MG/A)

OR 0.14 MICROGRAMS TCDD/SQ FT ($\mu\text{G}/\text{SQ FT}$)

AT 10 PPM TCDD IN 2,4,5-T BUTYL ESTER

3 GAL/A = 60 MG/A OR 1.4 $\mu\text{G}/\text{SQ. FT.}$