

## REMARKS ON THE DIOXIN LEVELS IN HUMAN POOLED BLOOD FROM VARIOUS LOCALITIES OF VIETNAM

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### I. INTRODUCTION

During the Vietnam War, several areas in South Vietnam were heavily sprayed by herbicides used for military purposes.

To understand the possible migration of the chemicals in the environment and to assess the actual dioxin contamination in each area of South Vietnam, from 1990-1993, with the cooperation of Dr. A. Schecter(1), we began to measure the dioxin levels in human pooled blood samples taken from different localities of South Vietnam, with the hope to map out the actual dioxin levels, that could be useful for future epidemiological and environmental researches.

### II. METHODS

Pooled blood samples taken from individuals living in a given area of South Vietnam were used for measuring dioxin levels of the area. The following conditions were required:

- Each sample of 100 ml of whole blood was obtained from 30 to 100 adults over 40 years old, living more than 5 years in the area (1-3 ml of blood/person). Since 1992, some samples were taken from younger age groups between 18-40.
- The sample was frozen immediately after collection and kept frozen until analysis for dioxin.
- Samples from north of Vietnam (Hanoi, Thanh hoa and Quang binh) (non sprayed areas), were also analyzed to serve as controls.
- From the north, one special sample is taken from veterans who had served in the south during wartime (Tay nguyen veterans), to compare with the general population.
- A short interview according to a same questionnaire was applied to each blood donor.
- Information about the spraying missions that occurred around the locality, at a distance of 10 and 30 km, are obtained from the Herbicide Program of 10-80 Committee, to study the potential correlation between actual dioxin levels and the quantity of herbicides sprayed around the locality.

The chemical analysis were done by:

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### III. RESULTS

We present in table 1 the analysis results of 43 blood samples from 36 different locations of Vietnam.

In this table, we can find some information concerning the blood donors (sample size, mean age)(column 4-5) TCDD and PCDD/F TEQ results (column 6-7) information concerning the spraying operations (average quantity of Agent Orange sprayed over the area within a distance of 10 and 30 km (litres/ha) (HERBICIDE PROGRAM 10-80 Committee) (Column 8-9-10) and information concerning the military zone (Westing)(1).

### IV. DISCUSSIONS

The table shows that:

1 - Total number of blood donors: 2722 of which there was 15 samples of pooled blood from 99-102 donors and others (28) were pooled from 33-50 donors/sample.

- From north Vietnam 3 samples (3 provinces: Hanoi, Thanh hoa, Quang binh) were collected (133 donors).

- 1 sample (35 donors) obtained from north Vietnam veterans who fought in wartime in Central highland (Tay Nguyen) and were exposed to the spraying operations.

- 39 samples from 32 south Vietnam localities (2254 donors),

- The information from those samples indicated that:

- 49,67% of the donors were male, 50,4% female

- 89,1% aged over 40, only 10,1% aged below 40

- 59,6% have been living in the area for more than 20 years,

- 12,4% between 10-20 years; only 6,3% less than 5 years.

2 - Referring to the number of spraying operations that occurred at a distance respectively within 10 and 30 km from the centre of the locality, we can remark:

- At a distance of 10 km from the centre: 6 localities were exempt from the spraying missions: They were: Hue (No 6), Danang (No 8), HochiMinh city (No 15), Chau doc (No 36), Long xuyen (No 37), and Rach gia (No 40). The remaining 26 localities were all hit from 3 to 58 times by the spraying missions.

- At a distance of 30 km, only 1 location was exempt from the spraying missions: It was Chau doc (No 36). All remaining localities were sprayed, the least was Rach gia (No 40) and Long xuyen (No 37) (1 mission, with an average quantity of Agent Orange respectively 18 and 56 l/ha) and the most: Tri an (No 32) 95 missions; 17.348 litres/ha), A luoi (No 17) 224 missions; 13.396 litres/ha).

3 - In considering all those documents together, remarks could be drawn as follows:

a. Almost all the samples from the South had much higher TCDD and Total PCDD/F-TEQ levels than the ones from the North:

Whereas in the North, non sprayed areas, the TCDD level is less than 2.9 ppt, almost of all the southern samples had higher levels varying from 3.4 to 32 ppt (except 3 samples (Phan rang, (No 14); Hoa thanh (Tay ninh) (No 17); Long xuyen (No 37)).

b. From the North the north Vietnam veterans exposed during their service in the south, (No 4) till now, still had a higher dioxin burden (TCDD: 6,3; TEQ: 40,3 versus respectively 2,7 and 15,2 (weighted mean) from northern general population.

c. Some localities in South Vietnam had 2 or 3 samples analyzed Danang (3 samples) Tan uyen (3 samples), Dongnai (2 samples), Bien hoa (3 samples). Those samples were obtained from different age groups.

It appears that in people living in a same area, older people are more likely contaminated than younger people.

d. In several instances, there was a correlation between the quantity of herbicides sprayed and the TCDD and TEQ levels. That are the case of Song Be, Tan uyen, A luoi, Giong Trom, Go quao, Quang tri, Hue...

e. Chau doc (No 36), Long xuyen (No 37) and Rach gia (No 40) were areas the least exposed to the spraying operations. There was no spraying mission both at two distances of 10 and 30 km around Chau doc, one spray with an average 18 and 56 1/ha at 30 km around Rach gia and Long xuyen. The analysis showed those localities also had the lowest dioxin levels in the south, respectively for TCDD: 4,5 - 2,2 and 4.9 ppt and Total PCDD/F TEQ: 16,8 - 10,5 and 17.3 ppt.

f. The highest TCDD levels were recorded in Tra noc (No 37) (TCDD: 33 ppt TEQ: 141 ppt); Tan uyen (No 22) (TCDD: 32 ppt, TEQ: 55 ppt); Bien Hoa (No 27) (TCDD: 28 ppt; TEQ: 47 ppt); Da nang (No 8) (TCDD: 18 ppt; TEQ: 77); A luoi (No 7) (TCDD: 15 ppt; TEQ: 23).

The high levels in Tan uyen and A luoi seem consistent with spraying missions (Tan uyen 5932 1/ha; A luoi (13396 1/ha) (distance 30 km).

But the 3 other localities (Da nang, Bien Hoa and Tra noc), were not so badly sprayed: Tra noc: 719 1/ha; Bien hoa 2298 1/ha; Da nang 185 1/ha) (distance 30 km). If we remind that those localities sit nearby 3 former american airbases, we believe that the high contamination of the inhabitants of these localities may partly come from the vicinity of the airbases and the chemical warehouses inside those airbases as well as the misuse of the emptied chemical containers (sold to the population to contain food, rice, water petroleum...) (See appendix 1).

g. Some area heavily damaged by the spraying missions, expected to show high dioxin levels, but in fact, the TCDD content did not seem parallely elevated:

For instance 2 localities: Hoa Thach (No 17) and Dong xoai (No 26): heavily sprayed areas (Hoa thanh: 8314 1/ha, Dong xoai: 6038 1/ha (distance 30 km) but the dioxin levels were not so high (Hoa thanh (TCDD: 1 - TEQ: 38,8) - Dong xoai (TCDD: 3,1 - TEQ: 8,7). If considering the records from the blood donors, we could remark that: 33% and 61% of them have been living in the area for less than 5 years, so newly moved to this area. Is it the reason for which dioxin levels are so low?

h. Of concern are the samples from Tay ninh province. In this province 5 samples were analyzed, 1 from Tay ninh township (No 16) and 4 from different districts of the province (Hoa thanh (17) Tan Bien (18) - Chau thanh (19) Duong minh Chau (20).

In wartime Tay ninh province was considered as the headquarters of the resistance, the terminus point of the Hochiminh trail and so was very heavily damaged by the chemicals.

That is also recorded in the Herbicide Program.

The blood collection was correct with the research design (except for Hoa thanh).

But, the dioxin levels were all lower than expected: Tay ninh: TCDD: 6.8 ppt, TEQ: 16 ppt; Hoa thanh, respectively 1 and 38.8 ppt; Tan Bien: 5.3 and 25; Chau thanh: 4.6 - 19.4; Duong minh Chau: 7 - 35.3.

In a previous study (2), similar remarks were noted that most of the fat tissue samples taken from Tay ninh showed a lower TCDD level than that taken in other area.

We wonder if some environmental factor (micro climate, geographical, geological structure) in the area has interfered with the dioxin contamination to humans.

## V. CONCLUSION

The results of 43 dioxin analyses of pooled blood sampling collected from different locations of south and north Vietnam indicated that:

- Most of the samples taken in the South had higher levels of 2,3,7,8-TCDD, the dioxin characteristic of Agent Orange as well as Total PCDD/F TEQ than the one from the North.

- Sample from north Vietnam veterans exposed to herbicides in wartime, shows higher TCDD and PCDD/F TEQ than the northern general population.

- Many samples showed a correlation between dioxin levels in blood taken in adults living a long time in a given area and the amount of Agent Orange sprayed over the area.

- The lack of correlation in some cases (former airbases) may be linked to the lack of information about the source of contamination, other than the spraying operations by aircrafts. Those sources were not recorded in our Herbicide Program, leading to underestimating the chemical exposure.

- Some environmental factors of certain areas, could also interfere with the dioxin contamination to people living in the area.

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## LITERATURE

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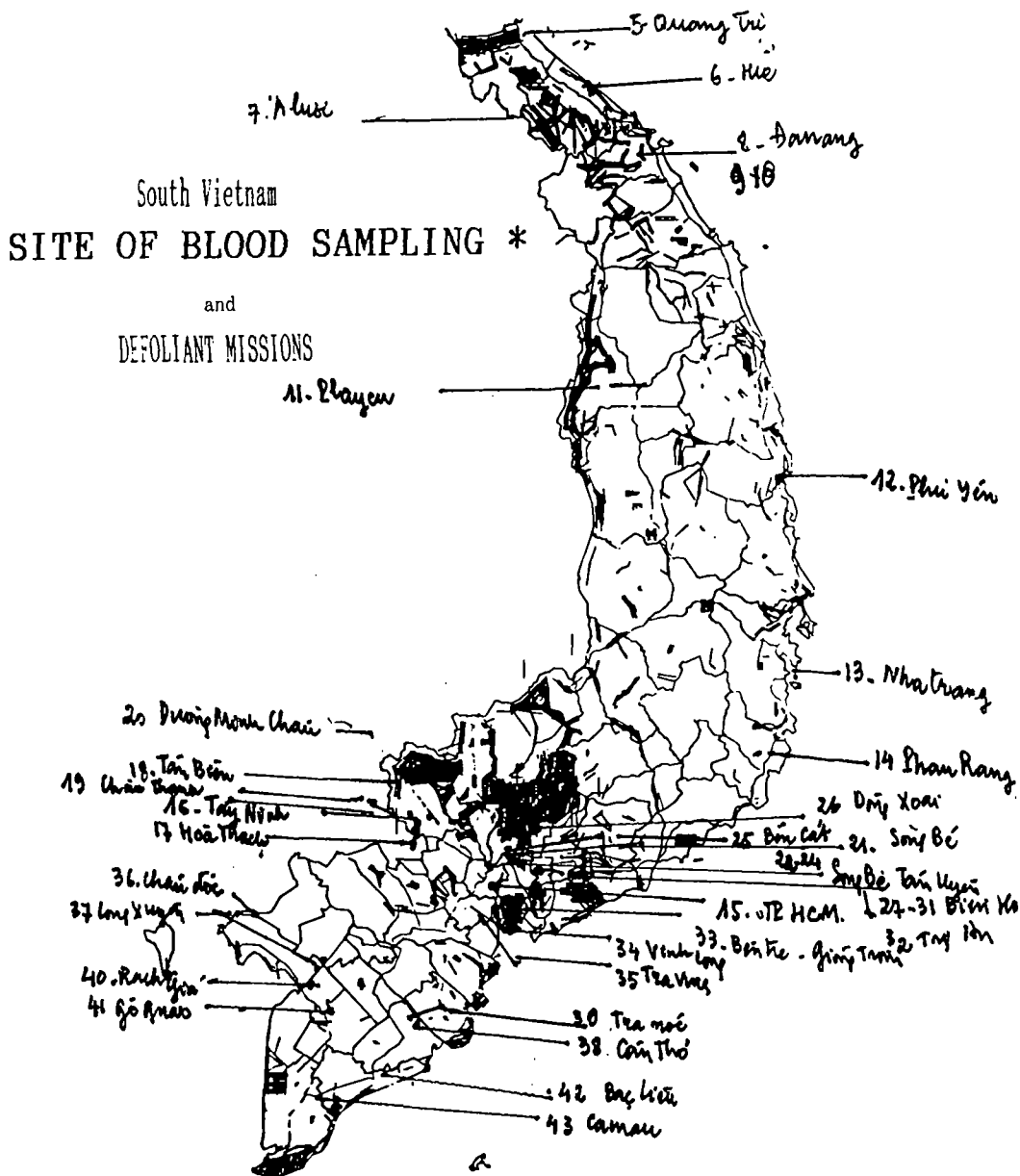
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**TCDD AND PCDD/F TEQ IN POOLED BLOOD SAMPLES FROM DIFFERENT LOCALITIES OF VIETNAM  
INFORMATION CONCERNING AGENT ORANGE APPLICATION OVER THE AREA**

No.	Locality	Date	Num. of Mean		TCDD	TEQ	Coordinate (UTM MAP)	Amount of A.O.		Other Information (Westing(1))
			donors	age				10 Km	30 Km	
1	2	3	4	5	6	7	8	9	10	11
North Vietnam										
1	Hanoi-Hoa. 103 (N)	3-91	33	45.27	<2.4	12	0	0	0	
2	Thanh Hoa	11-91	50	55.22	2.9	18	0	0	0	
3	Quang Binh-Dong	1-91	50	47.38	2.9	17.2	0	0	0	
Weighted mean					2.7	15.2				
4	Taynguyen veterans	11-91	35	48.43	6.1	40.3	0	0	0	
Military Region I										
5	Quang Tri-Quang Tri	1-91	50	50.98	9.5	34	YD 239604	467.02	6155.6	Area: 2.812.000ha
6	Thua Thien-Hue	1-91	30	56.67	11	57	YD 756224	0	6964.47	Pop.: 3.075.000
7	Thua Thien-A Luoi	1-91	35	51.6	15	23	YD 382001	1341.07	13396.81	Density:
8	Da Nang-Da Nang	2-91		59.12	18	77	BT 025775	0	185.06	Dioxin
9	D. Nang-D. Nang 18-	8-92	100	30.48	14	96.3	BT 025775	0	185.06	Mean (mg/ha): 10.3*
10	D. Nang-D. Nang	8-92	100	56.49	19	118	BT 025775	0	185.06	
Weighted mean					12.8	56.4				
Military Region II										
11	Gia Lai-Pleyku	1-91	50	57.28	4.2	34.2	AR 767473	18.9	9410.9	Area: 7.696.000 ha
12	Phu Yen-Phu Yen	1-92	43	50.7	6.2	26.4	CQ 186429	185.24	1939.77	Pop.: 3.088.000
13	Kh. Hoa-Nha Trang	1-92	50	48.64	4.1	29.5	CP 036539	18.9	200.14	Density:
14	Ninh Thuan-Ph. Rang	1-92	33	56.06	2.9	31.7	BN 815901	0	2082.11	Dioxin
Weighted mean					4.2	30.6				Mean (mg/ha): 4.6*
Military Region III										
15	HCM-Cho Ray	2-91	48	54.23	10.8	30	XS 875902	0	2423	
16	Tay Ninh-Tay Ninh	3-91	50	53.44	6.8	16	XT 239515	501.89	10598.79	Area: 3.021.000 ha
17	Tay Ninh-Hoa Thanh	8-92	100	49.58	1	38.8	XT 239465	651.25	8314.31	Pop.: 4.858.000
18	Tay Ninh-Tan Bien	2-91	50	59.72	5.3	25	XT 090810	2761.73	7223.44	Density:
19	Tay Ninh-Chau Thanh	8-92	100	53.87	4.6	19.4	XT 15615	520.79	6946.34	(except HCM City)
20	Tay Ninh-D.M. Chau	5-92	100	49.63	7	35.3	XT 297511	12.37	10644.31	Dioxin
21	Song Be-Song Be	3-91	47	47.09	9	48	XT 811140	1528.64	9763.17	Mean (mg/ha): 29.8*
22	Song Be-Tan Uyen	3-91	48	53.54	32	55	XT 955220	470.05	5932.96	
23	Tan Uyen (18-40 y.o.)	8-92	100	31.83	9.4	25.4	XT 955220	470.05	5932.96	
24	Tan Uyen (>40 y.o.)	8-92	100	50.64	5.7	18.9	XT 955220	470.05	5932.96	
25	Ben Cat - Song Be	8-92	100	52.69	12	49.8	XT 741332	1300.87	14760.76	
26	Song Be-Dong Xoai	8-92	100	50.23	3.1	8.7	YT 295960	656.98	6038.68	
27	Dong nai-Bien Hoa	3-91	50	50.96	28	47	XT 992105	172.79	2298.42	
28	Bien Hoa-Dong Nai	5-92	100	47.31	7.3	22.8	XT 992105	172.79	2298.42	

No.	Locality	Date	Num. of Mean		TCDD	TEQ	Coordinate (UTM MAP)	Amount of A.O.		Other Information (Westing(1))
			donors	age				10 Km	30 Km	
29	Bien Hoa-Dong Nai	91	100	missin	12	49	XT 992105	172.79	2298.42	
30	Dong Nai (> 40 y.o.)	8-92	100	52.88	19	53.7	XT 992105	172.79	2298.42	
31	Dong Nai (18-40 y.o.)	8-92	100	30.75	14	61	XT 992105	172.79	2298.42	
32	Dong nai-Tri An (S)	3-91	50	46.94	12	19	YT 193259	4858.6	17348.12	
			Weighted mean		12.1	34.5				
	Military Region IV									
33	Ben Tre-Giong Trom	8-91	34	55.24	10.2	29	XS 650220	403.68	2981.75	Area: 3.797.000 ha
34	Cuu Long-Vinh Long	8-91	51	59.14	4.3	16.9	XS 070332	0	726.72	Pop.: 6.614.000
35	Cuu Long-Tra Vinh	8-91	48	57.48	7.2	27.7	XR 480990	80.24	1252.91	Density:
36	An Giang-Chau Doc	8-91	46	56.09	3.5	16.8	WS 132835	0	0	Dioxin
37	An Giang-Long Xuyen	8-91	49	61.55	2.2	10.5	WS 470485	0	56.7	Mean (mg/ha): 4.0*
38	Hau Giang-Can Tho	8-91	52	60.56	4.8	16.4	WS 850095	177.88	700.63	
39	Tra Noc-Can Tho	8-92	102	51.47	33	141	WS 795155	215.68	719.53	
40	Kien Giang-Rach Gia	8-91	48	57.5	4.9	17.3	WS 100050	0	18.9	
41	Kien Giang-Go Quao	8-91	37	57.86	10.9	27.5	WR 350750	176.15	309.09	
42	Minh Hai-Bac Lieu	8-91	50	59.52	10.3	34.8	WR 800270	2689.26	3063.06	
43	Minh Hai-Ca Mau	8-91	52	59.02	7.2	19.9	WR 173134	19.69	932.83	
			Weighted mean		8.05	27.4				

\* Amount per unit area, assuming uniform distribution over the entire region (mg/ha).



\* The locality number is the same used on Table 1

