ANALYSIS OF WATER FROM WELLS IN SELECTED CALIFORNIA COMMUNITIES FOR RESIDUES OF 1,3-DICHLOROPROPENE, 27 ORGANOPHOSPHATES, AND 23 CHLORINATED HYDROCARBONS USED AS PESTICIDES

by

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SUMMARY

Tests for residues of the nematocide 1,3-dichloropropene (Telone, DD) at a sensitivity level of 100 ppt, and 27 organophosphate and 23 chlorinated hydrocarbon pesticides at a sensitivity level of 5 ppb, were all found to be negative in water samples from 54 wells supplying water to 30 towns in the counties of San Joaquin, Merced, Kern, Fresno, and Santa Barbara when sampled in January 1981. These domestic water supplies were selected primarily because of extensive previous use of 1,3-dichloropropene and, secondarily, because of extensive use of the other two groups of pesticides.

INTRODUCTION

Telone II is a widely used preplant soil fumigant registered for use on numerous field, fruit, and vegetable crops in California. The liquid formulation contains 92% 1,3-dichloropropene (1,3-D) as the active ingredient. Telone II was synthesised by the Dow Chemical Company in 1956 and has been extensively used throughout the United States. DD is manufactured by Shell Chemical Company and contains a lower percentage of 1,3-D. The major areas of usage of 1,3-D in California have been in the San Joaquin Valley and in the coastal counties of Monterey and Santa Barbara. The primary crops that have been treated include cotton, tomatoes, sugarbeets, broccoli, alfalfa, brussels sprouts, and other field, fruit, and vegetable crops. The mode of application is usually by soil injection at a minimal depth of 6 inches, using tractor-mounted shank injection equipment.

Since the suspension of the registration of DBCP (1,2-dibromo-3-chloropropane) in California in mid-1977, 1,3-D has been considered as a possible alternative nematocide for use on established crops. Experimental application on established crops, including but not limited to grapes, almonds, and peaches, has been conducted to evaluate phytotoxicity, crop response, efficacy, and worker exposure data under post-planting conditions.

The possibility of well water contamination is of major concern. Past studies have shown that a few pesticides, DBCP in particular, are capable of migration from their point of application down into soil and into aquifers. This migration has resulted in the appearance of low levels of pesticide contamination in domestic well water systems.

Since 1,3-D is under consideration as an alternative to DBCP, sampling of domestic water wells was undertaken to evaluate any migration hazard posed by increased use of 1,3-D. At the present time, there is no action level or tolerance for 1,3-D residues in well water.

Skin and eye contact with 1,3-D can result in severe irritation with possible edema, dermatitis, and necrosis of the exposed area. Gross contamination can cause nausea, vomiting, pulmonary edema, liver and kidney damage, anethesia, and death. However, no deaths in humans have been reported from 1,3-D exposure.

The locations of the wells involved were selected for their proximity to fields or vineyards in which Telone, Telone II, and DD had been used for several years. The wells involved were almost entirely municipal supply systems for domestic use. Since there had also been extensive uses of organophosphate and organochlorine pesticides in the same areas, it was determined that the water samples would also be tested for these chemicals.

METHODS AND MATERIALS

The survey areas were located using the California Pesticide Use Reports for 1975 through 1980 and discussions with the local farm advisors in the selected counties. Information on the well locations for urban residents in the selected areas within the counties was provided by the Sanitation Engineering Division of the Department of Health Services. Wells sampled were all supplying drinking water to urban and residential areas. None were irrigation or individual farm-use-only wells.

General information concerning well history was provided by the local water district's representative or by the owners of the wells.

The water samples were drawn from a faucet situated between the pump and the supply system, as physically close to the pump outlet as possible. A limited number of samples were taken from a post-storage faucet when a pre-storage faucet was unavailable.

The sampling containers were 1-quart mason jars that were either new and unused or had been baked for 12 hours at 160°C to remove any trace of previous material. The sample jars were filled with the water to be sampled, leaving as little air space as possible. A sheet of aluminum foil was placed over the mouth of the jar, and the jar was sealed with its own lid. Two samples were taken from each well. Information on the wells is given in Table 1.

The sample jars were chilled on wet ice, and analysis was completed within 72 hours of sampling. To analyze for 1,3-dichloropropene from the samples, a 150-ml aliquot of the water sample was transferred into a 500-ml boiling flask. A known quantity of ethyl acetate, typically 10 ml, was added. The sample was slowly distilled until all the ethyl acetate and several ml of water were collected in a Barrett trap. The trapped water was then drained off and discarded. The ethyl acetate was collected in a glass-stoppered test tube, shaken with granular sodium sulfate, and analyzed by electron capture gas chromatography for the compound of interest.

Chlorinated hydrocarbons and organophosphates were both extracted by partitioning into benzene. The presence of chlorinated hydrocarbons was determined directly by gas chromatography using electron-capture or Hall conductivity detectors. The presence of organophosphates was determined directly by gas chromatography using phosphorus-specific temperature controlled bead or flame photometric detectors.

RESULTS

The analytical results for 1,3-D are given in Table 2. None of the samples taken showed any detectable trace of 1,3-D. The organophosphates chlorinated hydrocarbons and screens also gave negative results. The minimum detectable level for 1,3-D was 0.1 ppb. The other pesticides examined for minimum detectable levels are given in Tables 3 and 4.

DISCUSSION

In the well water sampled, no residues of 1,3-D were revealed. The results of the testing for organophosphates and organochlorines were also negative. The data from these samples indicated that no detectable levels of the pesticides sampled for had as yet migrated into aquifers from which the sample wells draw their water.

Cis- and trans-chloroallyl alcohols which are breakdown products of 1,3-D were not analyzed in the water samples due to the rapid degradation of these breakdown products and the lack of an analytical method possessing greater sensitivity than the method of analysis for 1,3-D. Both methods have a minimum detectable level of 0.1 ppb. Chloroallyl alcohols are reported to degrade in soil at rates that were from 3 to 12 times as fast as 1,3-D, depending upon types of isomers, soil conditions, and temperatures (Van Dijk, 1974). Cis-chloroallyl alcohol was totally degraded within 6 hours by bacterial action, while trans-chloroallyl alcohol degraded approximately 7 times slower (Belser and Castro, 1971). Chloroallyl alcohols can become bound to soil components (Roberts and Stoydin, 1976).

The existence of degradation processes for chloroallyl alcohols plus evidence that only a fraction of 1,3-D is converted to chloroallyl alcohols at any given time (Roberts and Stoydin, 1976) would indicate that no detectable residues of chloroallyl alcohols would be present in ground water samples that had no detectable residues of 1,3-D.

REFERENCES

Belser, N. O. and C. E. Castro. Biodehalogenation - The Metabolism of the Nematocides Cis - and Trans-3-Chloroallyl Alcohol by a Bacterium Isolated from Soil. J. Agr. Food Chem. 19:23-26 (1971).

Roberts, T. R. and G. Stoydin. The degradation of (Z)-and (E)-1,3-dichloropropenes and 1,2-dichloropropone in soil. Pestic. Sci. 7:325-335 (1976).

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Table 1

PHYSICAL DATA FOR SAMPLED WELLS

Location		Depth (ft)	Type m - municipal p - private
1.	Ripon	158	m
2.	Ripon	300	m
3.	Ripon	200	m
4.	Manteca	370	m
5.	Manteca	207	m
6.	Raymus Village	295	m
7.	Livingston	-	m
8.	Livingston	-	m
9.	Atwater	320	m
10.	Hilmar	-	m
11.	Hilmar	-	m
12.	Merced	133	m
13.	Merced	155	m
14.	Winton	-	m
15.	Castle AFB	300	m
16.	Delhi	273	m
17.	Tranquility	450	m
18.	Caruthers	-	m
19.	Mendota	150	m
20.	San Joaquin	600	m
21.	San Joaquin	600	m
22.	Selma	120	m
23.	Parlier	180	m
24.	West Parlier	250	m
25.	Reedley	250	m
26.	Fowler	177	m
27.	Selma	260	m
28.	Selma	180	m
29.	Firebaugh	198	m
30.	Firebaugh	185	m
31.	Santa Maria	-	m
32.	Santa Maria	-	m
33.	Santa Maria	-	m
34.	Guadalupe	-	m
35.	Guadalupe	-	m
36.	Lompoc	65	p
37.	Lompoc	164	m
38.	Lompoc	195	m
39.	Santa Ynez	-	m
40.	Edison	700	m
41.	Edison	900	m
42.	Lamont	-	m
43.	Lamont	-	p
44.	Lamont	200	p

Table 1 (continued)

Location	Depth (ft)	Type m - municipal p - private
45. Lamont	-	m
46. Lamont	700	m
47. Shafter	400	p
48. Shafter	400	p
49 Shafter	240	m
50. Shafter	675	p
51. Shafter	700	m
52. Shafter	600	m
53. Wasco	922	m
54. N. Kern	1200	m

Information on wells was obtained from representative of well system. Where information was unavailable, the column has been left blank.

Table 2

ANALYTICAL RESULTS OF WATER SAMPLES

Area (County)	Number of Wells Sampled	Number of Positives		
		1,3,-D	Organophosphates	Organochlorines
San Joaquin	6	0	0	0
Merced	10	0	0	0
Fresno	14	0	0	0
Santa Barbara	9	0	0	0
Kern	15	0	0	0
Total	54	0	0	0

Table 3

Materials Capable of Detection by Organochlorine Screening Method Used
Sensitivity - 5.0 ppb

Aldrin
Botran
Captan
Chlordane
DDD
DDE
DDT
Dacthal
Dieldrin
Endrin
Heptachlor
Heptachlor Epoxide
Hexachlorocyclohexane isomers (BHC) including Lindane
Kelthane
Methoxychlor
PCNB
Perthane
Tedion
Endosulfan I
Endosulfan II
Endosulfan III
TOK
Toxaphene

Table 4

Materials Capable of Detection by Organophosphate Screening Method Used
Sensitivity - 5.0 ppb

Carbophenthion (Trithion)
Dasanit
DEF
Diazinon
Dimethoate (Cygon)
Dioxathion (Delnav)
Disulfoton (Di-Syston) (parent only)
Dursban
Dyfonate
EPN
Ethion
Fenthion (Baytex)
Guthion
Imidan
Malathion
Merphos (Folex)
Methyl Parathion
Methyl Trithion
Mevinphos (Phosdrin)
Parathion
Phorate (Thimet)(parent only)
Phosalone (Zolone)
Phosphamidon
Ronnel
Supracide
Torak
Trichlorfon (Dylox)