

MONITORING SELECTED GROUND WATER BASINS
FOR THE PRESENCE OF ALDICARB: A COOPERATIVE
CALIFORNIA INTERAGENCY STUDY

by

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Acknowledgments and Participants

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I. Introduction

Aldicarb (Temik) is a popular soil fumigant used on a variety of crops in California. It is normally side-dressed or broadcast in pelletized form and activated by irrigation. Water disintegrates the pellets, freeing the toxic material to be carried by the irrigation waters to the root zone. Aldicarb is effective when in direct contact with soil pathogens and also as a systemic pesticide taken into the plant.

Recently, the Environmental Protection Agency (EPA) has reported the presence of aldicarb and/or some of its degradation products in the ground water in portions of Long Island, New York (2). The Department of Food and Agriculture, the Department of Health Services and the State Water Resources Control Board agreed to cooperate in a limited study to sample selected ground water basins where high aldicarb use was documented and hydrological properties were deemed suitable for possible ground water contamination. This study's objectives were restricted to sampling two most likely areas of ground water contamination.

II. Materials and Methods

A. Selection of Sampling Sites

The following criteria were established for selecting study areas:

1. Proximity to high aldicarb application areas
2. High infiltration-percolation potential of topsoil
3. Highly permeable alluvium between the ground surface and the prevailing water table,

4. Relatively shallow water table with domestic use

After comparing aldicarb use in 1976 against these criteria, the following areas were selected for further investigation:

1. The Salinas River Valley upstream of Gonzales
2. Kern County, particularly in the Wasco-Shafter and Kern River fan areas
3. Eastside Central Valley portions of Fresno County
4. Palo Verde Valley, Riverside County

Upon further investigation the Palo Verde Valley was excluded because the soil in the aldicarb use areas tended to be more fine-grained. Also, the shallow water underlying this valley is seldom used for domestic consumption because of its salinity.

The remaining areas were field investigated to find suitable sample sites. Fresno County was eliminated because: 1) No community water systems were near the application sites; and 2) The water table was at greater depth in the aldicarb use area. Aldicarb's use maps for Monterey and Kern Counties for the 1979 growing season were reviewed with the respective county health departments to identify community water systems near the application sites. In addition, lists of shallow wells monitored by the Kern County Water Agency and the Monterey Flood Control District were compared with the use maps.

After evaluating this information the Bakersfield-Rosedale area of Kern County and the lower Salinas River drainage between the communities of Chualar and San Lucas in Monterey County were finally selected for sampling. Available information indicated that the depth to the water table exceeded 150 feet at all the sampled wells in Kern County while depth to the water table at the sampled Monterey County wells varied from about 40 feet at San Lucas and other localities near the river to approximately 145 feet east of Chualar.

Ground water samples were obtained from six wells in the Bakersfield-Rosedale vicinity of Kern County on November 27, 1979. Eight additional wells were sampled on November 29 along the lower Salinas River drainage between the communities of Chualar and San Lucas in Monterey County.

B. Sampling Procedure

Ground water samples were collected after letting water run from the well for about two minutes before sampling. Initially, water was collected in a 1-gallon amber glass bottle and divided into four separate 1-quart Mason jars. An additional 1-gallon sample was also taken. All jars were sealed using a teflon liner under the lid and stored in a chest with dry ice during transport to the State Chemistry Laboratory and to Union Carbide for chemical analysis.

C. Chemical Analysis

The important toxic residues of aldicarb in biological substrates are the sulfoxide and sulfone metabolites. The method of analysis employed in this study oxidizes aldicarb and aldicarb sulfoxide to aldicarb sulfone and determines the total aldicarb residue as aldicarb sulfone. All analyses were performed by Union Carbide at their Agricultural Products Research and Development Laboratories in South Charleston, West Virginia. A randomly selected number of the analyses (33%) were checked at the CDFA Labs in Sacramento, California. R. R. Romine (Union Carbide) and P. Lee (CDFA) performed the analyses. Ken Dunster acted as Union Carbide representative.

1. Reagents. Peracetic acid, 40 percent in acetic acid (FMC Industrial Chemicals, Philadelphia Penn.) Florisil, 60/100 Mesh PR grade (Floridin Co., Berkeley Springs, West Virginia). All other reagents and chemicals were analytical reagent grade,
2. Instrumentation. Gas chromatograph equipped with a flame photometric detector incorporating a 394 m μ filter specific for sulfur containing compounds, Column - 1/8" x 12' aluminum, packed with 5% carbowax 20M on 60/80 Mesh Gas Chrom Q (Applied Science Lab., State College, PA), Oven temperature - 160°C. Injector temperature - 300°C. Detector temperature 160°C. Carrier gas - N₂ at 60 ml/min. Detector O₂ flow - 25 ml/min. Detector H₂ flow - 200 ml/min. Liquid chromatography column - 200 x 13mm. I. D. glass, equipped with a 2mm Teflon stopcock and a 250 ml solvent reservoir,

3. Procedure . The procedure used has been detailed elsewhere (3) and will only be briefly described here. After thawing, 200 ml of the water sample was shaken with 2 ml peracetic acid and the mixture was allowed to stand for 15 minutes. Fifty ml of 10 percent sodium bicarbonate solution was added and after mixing, the solution was allowed to stand for 15 minutes with occasional swirling. Next, 50 ml of chloroform was added and shaken with the solution for 15-30 seconds. The layers were allowed to separate, and the chloroform layer was drained through a bed of anhydrous granular sodium sulfate into a collection flask. The aqueous layer was extracted three additional times with 50 ml aliquots of chloroform. Each of the extraction aliquots were drained through the bed of sodium sulfate. The sodium sulfate bed was finally rinsed with two 15 ml aliquots of chloroform. The combined extraction and washing chloroform aliquots were evaporated to a volume of 50 to 75 ml at room temperature. Next, the volume of the concentrated solution was brought to 100 ml in a graduated cylinder with chloroform. The 100 ml of solution was then poured through a 4 inch deep bed of florisil which had been previously wet with 15 ml of chloroform. The column was then eluted with 100 ml of a 5% acetone - 95% ethyl ether mixture and the elutant was discarded. The column was then eluted with 100 ml of a 50% acetone - 50% ethyl ether mixture and the elutant was collected. The solvent mixture was evaporated at a temperature of 40-50°C with a gentle stream of pre-purified nitrogen. Immediately upon obtaining dryness the collection flask was chilled in an ice bath and 1 ml of acetone was added.

The flask was stoppered and swirled to dissolve the residual pesticide" Aliquots of this solution were injected into the gas chromatograph.

4. Sensitivity, The method can detect levels of aldicarb sulfone ≥ 1 ppb. Recoveries of an equimolar mixture of aldicarb, aldicarb sulfoxide, and aldicarb sulfone from water detected as aldicarb sulfone average 95.5% (1).

5. CDFA Recovery Studies. Single run recovery studies were conducted for aldicarb and aldicarb sulfoxide to compare against Union Carbide recoveries. The result (90% for aldicarb and 99% for aldicarb sulfoxide each detected as aldicarb sulfone) compared very favorably.

III. Results and Conclusions

No aldicarb, sulfone or sulfoxides were detected in any of the samples from the 12 wells sampled in Kern and Monterey counties (Table 1). Both the Union Carbide analysis and quality control samples analyzed by the State Chemistry Laboratory proved to be negative.

This study met the stated objectives in monitoring two areas judged to have the greatest potential for aldicarb contamination in the ground water. In this case none was detected but care must be exercised not to extrapolate these results beyond the carefully defined scope of this study. These results do not pertain directly to any other area in the State or even to other wells in Kern and Monterey counties.

The negative results may be attributable to a wide range of factors. One possibility is that aidicarb (applied in the previous growing seasons) did not have sufficient time (by November 1979) to reach the water table. This would also include the shallow water table areas where the rate of unsaturated-saturated flow can be considerably slow or where local subsurface permeability variations can impede the vertical or lateral migration of possible aidicarb-contaminated waters. Studies by Baver (1) on the retention and movement of soil moisture show that unsaturated flow is a function of capillary potential versus gravitational potential and is a small fraction of saturated flow velocity.

Table 1. Summary of Aldicarb¹ Analyses from Ground Water Samples.

Sample No.	Residue (ppb)	
	Union Carbide	CDFFA
1	ND ²	
2	ND	
3	ND	---
4	ND	ND
5	ND	ND
6	ND	---
7	ND	
8	ND	
9	ND	ND
10	ND	
11	ND	---
12	ND	ND

1/ Analyses for aldicarb, aldicarb sulfoxide, and aldicarb sulfone, all detected as aldicarb sulfone.

2/ ND = none detectable, <1 ppb (weight/volume)

Literature Cited

1. Baver, L. D. 1949, Retention and movement of soil moisture. *Hydrology* 364-384.
2. *Pesticide & Toxic Chemical News* Vo. 7, No. 40 (August 29, 1979), Food and Chemical News, Washington D.C.
3. Romine, R. R. 1979. Determination of the total toxic aldicarb residue in water. Agricultural Products Research and Development Department, Union Carbide Corporation, South Charleston, West Virginia,.