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PESTICIDES DATA-COLLECTION ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN TEXAS

By

Douglas B. Manigold
U.S. Geological Survey

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PESTICIDES DATA-COLLECTION ACTIVITIES OF THE U. S. GEOLOGICAL SURVEY IN TEXAS

By Douglas B. Manigold

The water-resources investigations program of the Geological Survey has the objective of seeing that the Nation's water resources are appraised and that the necessary water data to develop and manage them efficiently are available when needed. In carrying out this objective, the Survey is the primary source of hydrologic data that are basic not only to the quantification of the water resource but also to its development and conservation. In recent years, the need has developed for the Survey to provide data and technology to predict the impact of man's activities upon the water resource and the water environment.

To accomplish its mission, the Geological Survey determines the source, quantity, quality, distribution, movement, and availability of both surface and ground water. This work includes the assessment of the chemical, physical, and biological quality of water resources and its relation to various parts of the hydrologic cycle; research to improve the scientific basis of investigations and techniques; design and operation of a national water-data network; and publication of its investigations.

In the early 1960's the Geological Survey began developing methods formeasuring concentrations of pesticide residues in water. In the fall of 1965, the Survey initiated a monthly monitoring program on 11 streams in the western United States, including 3 in Texas, screening for 9 of the more commonly used organochlorine insecticides: Aldrin, DDD, DDE, DDT, dieldrin, endrin, heptachlor, heptachlor epoxide, and lindane. Later, the herbicides 2,4-D; 2,4,5-T; and silvex were added. Initially, analyses for this program were made in the Survey laboratory in Sacramento, California.

As concern about the fate of pesticides and their effect on the water environment grew throughout the country, the Texas Water Development Board arranged for the Texas District of the Geological Survey in 1967 to initiate a quarterly monitoring program at 26 sites on the principal streams of the State and a survey of the occurrence of pesticide residues in ground water. The laboratory equipment at Sacramento was moved to Austin and a laboratory was established to support the Texas work, the western monitoring network (expanded in 1967 to 20 stations), and to provide analytical services for Geological Survey Districts in States west of the Mississippi River.

For a number of years, the Geological Survey has made studies of streamflow in urban areas to determine the changes in runoff characteristics that result from continuing urban development. In 1968 the collection of a wide variety of water-quality data, including pesticide residues, was added to studies underway in the Houston and San Antonio areas. By 1970, the Geological Survey had developed methods for measuring pesticide residues in sediment, and in that year, the quarterly analysis of stream-bottom materials at 39 sites was added to the data collection program in Texas.

Since October 1967, the Geological Survey has been engaged in a cooperative study (with the Texas Water Development Board) of the chemical and physical characteristics of the estuaries of Texas. The purpose of the study has been to provide the Texas Water Development Board information to assist them in preserving the valuable water resources of the estuaries. Water-quality data, including pesticides, on the major streams of the State contribute to the estuarine studies. Also needed is information on the contribution of the many small streams flowing directly into the estuaries. In 1970, eleven small streams were selected for collection of runoff and water-quality data including pesticide analyses of water and bottom materials.

Samples for pesticide residue analyses were collected in quart glass bottles that had been washed, rinsed with distilled water, heated at 300° C. for 8 hours, and capped with teflon-lined lids. Most samples arrived at the laboratory within 3 days of collection, were refrigerated until analysis was begun, and were extracted within about 3 weeks of receipt.

Analytical methods used for the determination of insecticide residues in water and in bottom materials are described by Goerlitz and Brown (1972). Methods used for determining chlorinated insecticides associated with sediment are also described by Goerlitz and Law (1974). The method for insecticides in water consists of extracting the entire sample with three 25-ml parts of pesticide-grade n-hexane, concentrating the extract, followed by cleanup on an alumina micro column. Bottom materials are thoroughly mixed and 50 to 100 g are extracted three times with pesticide-grade acetone alternating with three extractions with hexane. The extracts are combined, washed with water to remove the acetone, dried over sodium sulfate, concentrated and cleaned up with alumina.

Insecticide residues were identified by dual-column electroncapture gas chromatography. Concentrations in excess of 1 microgram per liter were confirmed by microcoulometric or electrolytic-conductivity detectors, and in some cases by gas chromatography-mass spectroscopy.

Lower reporting limits for insecticides in water are 0.01 µg/l (microgram per liter), except that for chlordane and toxaphene the limits were 0.05 and 0.5 µg/l, respectively. Lower reporting limits in sediments were 0.2 µg/kg (microgram per kilogram) for most insecticides, but they were 1 µg/kg for chlordane and 10 µg/kg for toxaphene.

Pesticide data from Geological Survey programs are routinely published. Analyses for the network of stations in the western United States have been published in the Pesticides Monitoring Journal (Brown and Nishioka, 1967; Manigold and Schulze, 1969; Schulze, Manigold, and Andrews, 1973). Data for streams in Texas for the 1968-1972 water years have been published by the Texas Water Development Board and by the Geological Survey. (See list of references.) Pesticide analyses from the estuarine program are published by the Texas Water Development Board (Hahl and Ratzlaff, 1972, 1973). All pesticide data from stations with precise location identification have been entered into the Geological Survey Water-Quality File and thence into the STORET system maintained by the Environmental Protection Agency.

Geological Survey pesticide data for 108 sites on nontidal reaches of streams in Texas have been summarized by Rawson (1974, p. 37-48). For each site, he tabulated the number of analyses, the number of occurrences, and the range of concentration of each pesticide, and the number of samples with concentrations in excess of recommended environmental levels and in excess of recommended limits for public water supplies. With respect to aldrin and dieldrin, Rawson stated (p. 41 and 42):

"Aldrin.--The concentration of aldrin in 1,385 samples from 108 sites ranged from 0.00 µg/l in most samples to 0.57 µg/l in a sample from Brays Bayou at Houston (site 65). Aldrin was detected in only eight samples from seven sites. Only three samples (one each from three sites on streams in the urban area of Houston) contained more than 0.05 µg/l, the maximum environmental level for marine waters, as recommended by the National Technical Advisory Committee (1968). No samples contained more than the recommended 17 µg/l limit for water to be used as a public supply."

"Dieldrin.--The dieldrin content of 1,385 samples from 108 sites ranged from 0.00 µg/l in many samples to 0.60 µg/l in a sample from Greens Bayou near Houston (site 75). No samples contained more than the recommended 17 µg/l limit for public water supplies, but 111 samples from 30 sites contained more than 0.05 µg/l, the maximum recommended environmental level for marine waters. Most of these sites are in the urban areas of Houston and San Antonio."

In summary, Rawson states (p. 50):

"Analyses of water samples collected periodically from 108 sites on nontidal reaches of most of the principal streams and many small streams show that small amounts of some of the pesticides studied are widely distributed in surface waters in Texas. The most widely distributed chlorinated-hydrocarbon insecticides at the sites studied were dieldrin at 77 sites, DDT at 67 sites, lindane at 59 sites, and chlordane at 38 sites. The most widely distributed phosphorothioate insecticide was diazinon, which was detected at 80 sites. Small amounts of each of the chlorinated-hydrocarbon herbicides were widely distributed (2,4,5-T at 96 sites, 2,4-D at 78 sites, and Silvex at 47 sites). Although only chlordane, in 2 samples from 1 site exceeded the maximum limit recommended for water to be used for public supply, 1 or more pesticides in at least 1 sample from 57 sites exceeded the maximum environmental level for marine waters recommended by the National Technical Advisory Committee."

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